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The New York Rapid Transit Franchise. THE prospects of the success of the underground rapid transit road in this city, instead of increasing with the approach of the date of sale of the franchise, on the contrary appears to be becoming less hopeful, at least if success includes freedom from corrupt political influences. In view of the coming sale our contemporary, *Engineering News*, gives an analysis of the terms and conditions in the sale of the franchise, in which it points out, what appears to have been left unnoticed by all the newspapers, that the conditions are such as to be very discouraging to any bona fide company, while they are very favorable to parties who are "solid" with the powers. It also deplores the fact that there are no provisions by which the city will receive proper return for this valuable franchise. It is to be regretted very greatly that this enterprise, the first introduction of rapid underground transit by electric means in this country, is to be thus hampered by corrupt political influences.

High Speed Railroad Records Broken. WHILE electrical traction is promising to encroach on the large territory heretofore enjoyed exclusively by the steam railroad engineer, the latter has not been idle. One of the new Vauclain compound locomotives which were introduced lately on the Philadelphia & Reading Railroad it is claimed broke the record the other day for one, two and five miles on the line between Philadelphia and New York. One mile was made in 37 seconds, which was equal to a rate of 97.3 miles per hour; two miles were made in 75 seconds, and five miles in 205 seconds, which correspond respectively to a rate of 96 and 87.8 miles per hour. The locomotive was drawing the usual train, and the time was taken with a stop watch. While this was an exceptionally fast run it nevertheless was not much above the normal schedule speed. From all reports the engine ran well, but the question still remains whether it is practicable to run such heavy machines with rapid reciprocating parts and remain within reasonable limits of safety.

Recent Developments of the Steam Turbine. SOME years ago the introduction of the steam turbine created quite a sensation, great claims being made for it. Although in a number of points it had great advantages over the reciprocating steam engine its poor efficiency limited its application at that time to plants where efficiency was of no importance. But from some tests made recently by Prof. Ewing it appears that recent improvements have now placed it on a par with the usual forms of steam engine as regards efficiency, and it is therefore possible that its introduction may now become quite common. There are no reciprocating parts and the speed is very high, being in this test 80 revolutions per second. The improvements made recently, which have brought its efficiency up to that of cylinder steam engines, are in the addition of a few more turbines to adapt it to higher pressures and in the superheating of the steam; there being no lubrication and no packing in the passages traversed by the steam. superheating is attended by no disadvantages. From Prof. Ewing's tests the efficiency at present is 15.7 pounds of steam per indicated horse power hour, at full load, and 17 at half load. If the present claims are substantiated, its introduction for electric lighting purposes may create quite a revolution, especially in central station design, where its substitution for the present steam engine would be accompanied by a number of other changes.

Possible Electrical Effects of the Comet. IN connection with the much talked of possible collision of the earth with that ill behaved visitor who has been unnecessarily disturbing the minds of many people, it may be of interest to mention here some remarks made by Mr. Fitzgerald, in an English contemporary, on some electrical features of comets. Regarding comets' tails he says it is known that they are explicable on the hypothesis that the sun is powerfully electrified and repels similarly electrified molecules with a force of some moderate number of times the gravitation of the molecules to the sun. Or, in other words, they are repelled by a stronger force than the attraction of gravitation to the sun. In discussing the hypothesis that a sun spot is a source from which some emanation like a comet's tail is projected, he says that the quantity of matter that must exist in this cometary beam in order to act as an electric current on the earth is easily determined. Assuming that each atom has the usual atomic charge, he, together with Dr. Lodge, calculated that a few cubic metres of hydrogen at atmospheric pressure and temperature spread over a volume a thousand miles cube would represent a current of some thousands of ampères. This, he thinks, is sufficient to make quite a magnetic disturbance on the earth. If we may assume that these statements are reasonable, telegraphers and navigators may be the only ones who would be materially disturbed by a collision with this unwelcome visitor. As to the telegraphic lines, the Western Union Company noticed no unusual earth currents during the time of the supposed encounter. Probably the most serious effect of this intruder has been the disturbance of the minds and the loss of sleep of ignorant and superstitious people, chiefly negroes and women, who, it appears, prayed in the churches until late Sunday night. It is to be regretted that this comet contributed nothing more useful to our knowledge of such erratic celestial disturbances, especially as such a collision is as rare as that of hunters' bullets, as the astronomers put it.

Lower Frequencies. THE question of what is the best frequency to use in alternating current systems is, like many others that come up in engineering, a choice between two evils, so to speak, and it is for this reason that it admits of so much argument, and will probably remain for a long time to come a question about which very wide differences of opinion are held and one which can be definitely settled only for special cases. A choice between using low and high frequencies in alternating current work is precisely analogous to that between high and low speeds in direct current dynamo construction. If high speeds are used the dynamo becomes smaller and cheaper, while for slow speeds it becomes larger and more expensive. Similarly the higher the frequency the smaller the transformer, and vice versa. The question of a choice is therefore governed entirely by circumstances which may and do differ very greatly with different installations. Where cheapness is the main object high speeds and high frequencies will continue to be used, while whenever the cost is secondary to reliability and other similar advantages, slow speeds and low frequencies will be used. As regards the dynamo, the question is more easily settled, because the speed affects nothing beyond the dynamo. But a change of the frequency affects all the apparatus; to have different frequencies in different installations therefore means to have special apparatus for each frequency. It would be very desirable to settle on one or perhaps two frequencies, and then to adhere to them, even though they may not be the best for each special case. Mr. Watts, in an article published in another column, advocates very strongly a reduction in the frequency to one-fourth of what is generally used now. Desirable as this may seem from his arguments, we fear that this might be going to the opposite extreme. While there are many good arguments which can be made in favor of low frequencies and slow speeds, the fact remains that as long as people will prefer cheaper apparatus, even though less reliable and satisfactory, so long will high frequencies and speeds be preferred by the manufacturer who has to compete with others. Perhaps the best plan would be to educate the people by adopting, say, two frequencies, one being one-half or one-third the other, and then letting the purchaser take his choice, There are many cases in which a purchaser will see the advisability of buying a more expensive but more satisfactory article in preference to a cheaper one, provided both are offered to him by the same manufacturer, but if what appears to him to be the same thing is offered to him by different manufacturers he will invariably take the cheaper.

The Cost of Generating Electricity. THOSE interested in the cost of generating electricity in central stations will find the paper by Dr. Hopkinson, in another column, well worth their most careful consideration. Although the points he makes are not entirely new, yet they are made in such a way that they cannot fail to appeal to those concerned with the problem of generating electricity and selling it in the most profitable way, considering both the side of the producer and the consumer. Dr. Hopkinson attacks the problem in the following way, which every one must admit is very rational, even though exception might be taken to some of the minor points. He divides the expenses into two parts, a fixed part which includes those expenses which are independent of the *amount* of electricity actually generated, that is, the cost of merely being ready to generate it, the second part including only those expenses which increase directly with the electricity generated. It will doubtless surprise many who have not looked into this question to see what a very large proportion of the total cost the former is. The actual total cost of the electricity, according to the figures he assumes, is dependent much more on the cost of being ready to generate than on the additional cost of actually generating it. Looking at the problem in this way leads to conclusions which are well worth the attention of central station managers. If, for instance, the cost is thus divided into two parts the most rational way to charge for electricity would be to divide the charges into similar parts, instead of having, as is usual, a fixed price per watt-hour consumed. If a consumer pays a certain definite sum for being ready to use electricity, whether he uses it or not, and in addition a charge per kilowatt-hour of electricity actually used, then the income of a station will run parallel, so to speak, with the cost of operating. Charging in this way, the cost per unit consumed will be very small, so small in fact that consumers will, when once connected, feel freer to use the current, which is an advantage to both parties. Such a rate of charging also settles the question which often vexes the central station manager, of the desirability of consumers like those in dwelling houses, who install many lights but use only a few for a short time. The station must hold itself ready to run all of these customer's lights, while during most of the time only a few lamps are in use and are yielding a return to the station; the company gets nothing at all for holding itself ready to run the other lights, although it costs very much to do so. To a certain extent this proposed method is already introduced in many stations by having a fixed charge for the meter, but it would, no doubt, be to the advantage of most stations to make a much greater difference in these charges by increasing the meter charge very materially and diminishing very greatly the charge per unit consumed.

The Chicago & St. Louis Electric Railway.

We printed in our last issue a rumor that was published on Wall Street just as we were going to press to the effect that the General Electric Company would back the Chicago & St. Louis Electric Railway. Two days later the same financial bulletin printed the following regarding the report as published:

We are informed that the General Electric Company has no idea of backing the Chicago & St. Louis Electric Railway enterprise financially. The company is in the field for business and is of course desirous of equipping this road or any other requiring electric apparatus.

The General Electric Company, according to our informant, has made no investigation of the feasibility of the plan or the likelihood of its success. The issue of the $6,000,000 bonds, it is stated, has nothing to do with this enterprise or any other, but is simply the carrying out of plans determined by the directors and apparently means no radical departure in policy.

It is assumed, of course, that the General Electric Company or any other would be glad to get the contract for equipping the Chicago & St. Louis Electric Railway, as this would mean the supply of machines and apparatus aggregating a very large amount of money, that should a cold shoulder be turned to the enterprise, would go to a competing company. The railway company's stock is being taken up as fast as the successive issues are placed upon the market, and construction work and the securing of new properties for power houses and sub stations is going on satisfactorily.

Laboratory and Library.

BY PROF. C. WELLMAN PARKS

My experience as a teacher of physics in our oldest engineering school and my observation of the methods pursued and the results obtained in the best educational institutions of the world have convinced me that the patrons of our colleges and scientific schools have been allowing the glamor of the laboratory to eclipse the constant life-giving glow of the library as a factor in education. I would not be understood as in any way hostile to laboratories, for I certainly believe that very few people are so constituted that they can become great leaders in science without access to laboratories that are worthy of the name. What I do decry is the impression that whatever is called laboratory is good, and whatever is called library is dry, old-fashioned, and not worthy of our attention. This impression must be attributed to impulse rather than judgment, and to the prevalence of the opinion that we live in an age of development such as the world has never known before the latter half of the nineteenth century. Even allowing that the progress has been greater than was ever known before, how is the laboratory to displace the library as an educational agency? Are all of the developments of such recent date that the teachers have been eye-witnesses, and can review them in laboratory from personal observation? When this matter is subjected to reason no judgment can be formed until it has been determined of what good laboratories and libraries consist, and the part that each is supposed to perform in the education of man.

The first requirement of a laboratory is the same as that of a library—humanity. This cannot be purchased and placed on shelves or in cases. Without a man of kindness, erudition and wisdom, no amount of money expended for monumental buildings and costly apparatus can produce a laboratory in which the young student can afford to spend his time. Without such a man the so-called laboratory becomes a playroom or worse. The next requirement of the laboratory is a sufficiently large number of trained assistants. Often the assistants are recent graduates who have the best of intentions, but not the requisite experience.

Faults in the first and second requirements are most often due to the financial condition of the institution. A good laboratory is a costly thing to provide, and much more costly to maintain, so that it is almost impossible for more than a few of our wealthiest institutions to maintain them. In fact, I doubt whether they can be advantageously maintained independent of the aid of state or national government. I believe that institutions should co-operate in the maintenance of laboratories.

The third requirement of the laboratory and the library is a complete collection. The laboratory should be as complete as possible in some lines, and should not be wholly wanting in any line. The same can be said of the library.

The fourth requirement is proper provision for accessions, renewals, and supplies. The fifth requirement is that the library or laboratory shall be open for the use of students at all reasonable times.

If it can be stated that the purpose of the higher educational institutions is to develop the man, to store his mind with useful information, and to strengthen his powers of perception, judgment and memory; we may find the relative merits of laboratory and library by asking ourselves which of these serves our purpose best.

Is not the laboratory method necessarily slow if good? If it is slow then the library is better to store the mind with useful facts. Again, can any student give careful attention to any exercise of exact measurement without strengthening his perceptive faculties? Will not his knowledge of this special exercise be increased more than it would have been had he simply read an account of the experiment? Can the student judge correctly from the evidence presented by the exercise in hand without consulting authorities? My inference is that no laboratory can be properly managed without a reference library constantly at hand.

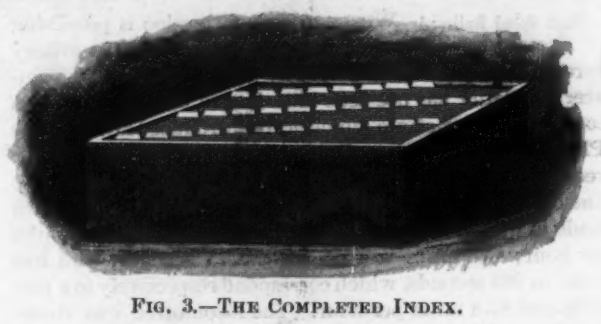


Fig. 3.—The Completed Index.

The most common defects in laboratory facilities of the American colleges are: Lack of trained teachers, lack of apparatus, and small number of hours that they are open to the students. Some institutions do not give their students more than twenty-five hours each in the laboratories during the whole four years' course. Others limit the time in which the exercises are to be performed. Either method gives little return for the money invested. I think that all will agree that if the library is not more valuable than the laboratory it can at least be more frequently and more easily used.

The regard that an institution has for its library is shown by the accessions and the kind of librarian in charge, and the quality of work done by the faculty is shown by the number of books and the kind of books loaned to students. In order that the library may be most available it should have the books arranged according to some good system, and should possess a good annotated card catalogue.

Of course an institution that adheres closely to text-book recitations has no use for either laboratory or library, and I suppose that it is contented with graduates who are narrow-minded. That there are such in the country can be inferred from remarks that have been made in educational conventions. I do not believe that the recitation method ever really made a student, and I do not believe that it is useful with a fifth of the candidates for admission to our colleges and scientific schools.

For an example of a valuable collection of books that is little appreciated and little used I do not think it unjust to refer to the library of the Polytechnic in Troy. Very likely it represents the condition of most of the college libraries of the country. I infer this from the tables printed in the reports of the United States Commissioner of Education. This library, made up to a great extent of valuable government reports, and bound volumes of technical periodicals, contains from four to five thousand volumes unclassified, uncatalogued, and unused; unclassified because books of the same class are to be found in all parts of the library—for example the patent office reports are in the southeast, southwest, and northwest corners of the library; uncatalogued because the latest catalogue was printed some time in the '70s; unused because it was open to students only about 200 hours during the year, and less than 100 books were loaned to students, of whom there were about 170 in attendance.

In conclusion I will enumerate the qualities that I believe necessary in an institution in which a student can afford to spend his time and where the parent will feel that his money has been well expended. They are: First, An able president, dean or director whose sole ambition is the success of the institution, and whose time, strength and energy are devoted to the promotion of its interests; Second, a library of good books well classified, under the charge of an able librarian, and available to the students at all proper times; Third, laboratories under able directors, provided with trained assistants, furnished with serviceable apparatus, and always open for work.

Alphabetical Index by Subjects for Practical Men.

BY F. G. BOLLES.

The advanced state of science of the present day makes the necessary indexing of its literature no small task, and draws upon the ingenuity of its readers to accomplish this in the most practical manner.

The index usually accompanying all periodicals is good enough for what it was intended, i. e., the indexing of the particular number in which it is printed, but when it becomes necessary or desirable to locate an article on some particular subject, and several months have elapsed since it was read, it usually results in a good deal of valuable time lost and patience severely tried.

With the average man pursuing any of the engineering professions, it is quite an impossibility to do more than take a hurried glance at the many valuable articles as they are published. New theories, formulas, etc., are continually being brought out, and it frequently happens that at a time when his duties are pressing he finds something of special interest to him. He lays aside the book or paper in which it appears, fully intending to read it carefully at the next opportunity. Perhaps this opportunity may not come for several days, perhaps weeks. In the mean time he has forgotten in what issue the article appeared. Hence to find it he commences to search, and, as is usually the case, the last paper remaining in the files is the desired number. It was in the endeavor to avoid losing valuable time and trying one's patience that the writer devised the system about to be described.

The index consists of a suitable number of cards contained in a box of proper size. At one edge of the card is a projection upon which is printed the subject—in the case of Form 1 "Power Transmission"—or the letter of the alphabet with its accompanying vowel—in the case of Form 2 "Co."

The body of the card has printed upon it a suitable form as shown in Figs. 1 and 2. Form 1 represents one of the cards used, and for most cases is the more desirable because of its completeness, indicating to what particular part of the subject the article relates, the name of the author, name of the paper with volume, date and page. Its capacity, normally, would be about 4,500 articles, covering 175 subjects. Its actual capacity, however, is unlimited, as extra blanks of bond paper (the original cards being of heavy bristol board), can be added under each head as may be found necessary.

Form 2 is a representation of a similar index of greater capacity, but less desirable for most purposes because of a lack of identity in the articles under each head. Its capacity is normally about 39,000 articles, but as in the case of the first form described can be supplemented by blank forms when the originals are exhausted. The method of filing the cards of Form 2 is identical with that of any vowel index.

The space required for the box containing an index of this kind (see Fig. 3), would be about 6 by 9 inches by 3¼ inches high. The advantage claimed for an index of this kind is that it furnishes a ready means of systematically indexing desirable information, the user being the one to select such articles as are of particular interest to him and avoiding the incorporation of a multitude of useless ones.

RELATING TO	AUTHOR	PAPER	POWER TRANSMISSION MONTH	DAY	YEAR	VOL.	PAGE
Turbines for		*Elec. World*	*May*	*14*	*92*	*19*	*340*
Lauffen-Frankfort installation	*Carl Hering*	" "	*Jan.*	*9*	"	"	*20*
Laws governing same and how applied	*W. M. Schlesinger*	" "	*Mch.*	*5*	"	"	*154*
Frankfort, Niagara Falls & other plants	*Carl Hering & others*	" "	"	"	"	"	*162*
Advantage of multiphase alternating currents	*D. C. Jackson*	" "	*Jan.*	*30*	"	"	*70*
Niagara and Chicago		" "	*Oct.*	*24*	*91*	*18*	*300*
Cotton Mills	*C J. H Woodbury*	" "	*Nov.*	*5*	*92*	*20*	*309*
Niagara construction		" "	*Feb.*	*6*	"	*19*	*85*

FORM 1.—SPECIMEN OF INDEX CARD.

COMMUTATOR			COMBUSTION			CONDENSER			CORES			CONVERTER			CONDUIT			CONDUCTORS			CONVENTIONS			COPPER			Co. COAL CUTTER		
PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE	PAPER	VOL.	PAGE
						E. W.	*19*	*384*				*E. W.*	*19*	*261*	*E. W.*	*19*	*14*				*E. W.*	*19*	*152*	*E. W.*	*18*	*312*	*E. W.*	*19*	*171*
						"	"	*23*				"	*20*	*243*	"	*18*	*9*				"	"	*169*	"	*20*	*299*			
												"	*18*	*9*	"	*20*	*37*				"	"	*170*						
												"	*20*	*40*	"	*19*	*309*				"	*20*	*281*						
												"	"	*216*	"	*20*	*292*				"	"	*272*						
												"	*19*	*369*															

FORM 2. SPECIMEN OF INDEX CARD.

The Electro-Metallurgy of Zinc.

In order to prevent zinc from being deposited in a spongy state with the occlusion of hydrogen, Messrs. Siemens & Halske have added to the electrolyte a substance capable of combining with the hydrogen as fast as it is produced. This substance should be a weak solution of chlorine, bromine, or iodine, or hypochloric or hypobromic acid, or even an organic compound of chlorine such as hydrochlorine of glycerine, or gylcol. The quantity added should be very small, and the deposit will be found to be quite solid.

Applications of Electricity to Agricultural Work.—I.

THE fact that there seems to be opening up a vast field for the electric motor in the performance of agricultural work makes it of interest to examine in detail the character and extent of the various farming operations to which the electric motor is adapted. That a demonstration of the success of electric power when applied to the numerous farming operations now performed by the horse or the human laborer would bring about an unparalleled demand for electrical apparatus is certain, since it is well known that the enterprising farmers are always among the first to secure the best and most efficient appliances for carrying on their work. In no place are labor saving appliances more numerous than on the farm, and there is no class of work in which apparatus designed to relieve the life of the farmer of some of the drudgery and unpleasantness so often reputed to be an inseparable part of his daily routine is so quickly appreciated and adapted to everyday use.

The poet sings melodiously and the novelist charms us with his stories about the beauty of the farmer's life and

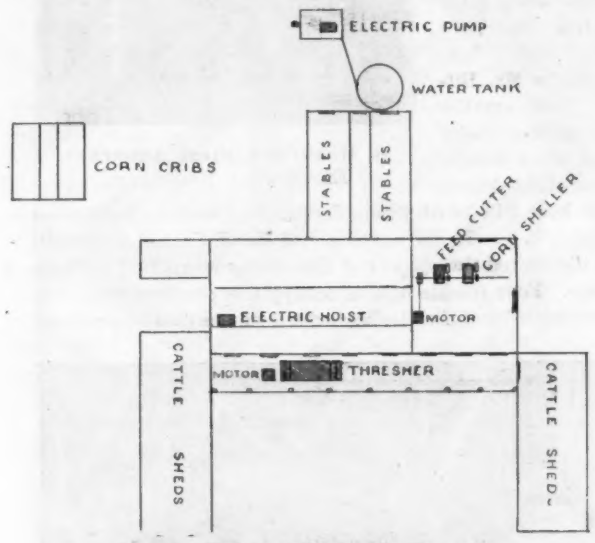


FIG. 1.—PLAN OF FARM BUILDINGS.

the elegance and luxury of his surroundings; but the sterner reality of his work-a day toil is more often passed over in silence. Luckily, however, the inventor, leaving aside poetry and fiction, has brought to the farmer a relief that has far and away eclipsed the consolation afforded by the poet's verse or the beguiling story of the humorist. To the husbandman who earns his daily bread by the sweat of his brow the ingenious inventor has brought the plow that turns the sod in the fields of every land; the drills and the planters that so quietly but rapidly drop the seed into the earth; the reaper that harvests the grain and the thresher that prepares it for the granary or the market, to say nothing of the hundreds of appliances used in his everyday

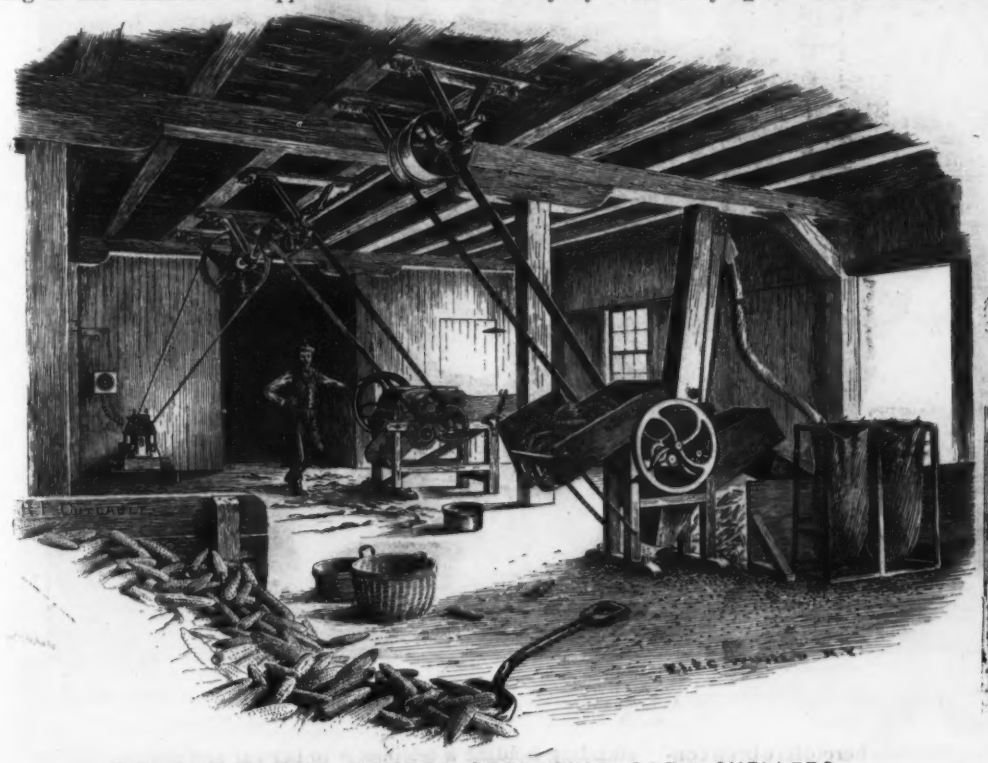


FIG. 3. ELECTRIC MOTORS OPERATING CORN SHELLERS.

work. All these have assisted in placing the farmer of to-day in the strong position which he undoubtedly occupies in the commercial and political world.

But it is not our purpose here to discuss in detail the benefits that have accrued to the farmer in return for his ready appreciation of the value of labor-saving machinery. It is sufficient for our purpose merely to recall the fact that the reader may bear in mind the results that have been due to a half century's enterprising and intelligent use of the brain as a guide for the hand in compelling the forces of nature (too often, however, an overworked beast) to become the servant of man, and to assist in gaining an idea of the nature of the field in which electric power may before many years find an extended use.

It should be pointed out, however, that the agricultural industries of the country are far behind many others in the use they are able to make of nature's forces. This is undoubtedly due to the isolated character of the work and the necessity which very generally exists for conveying the power to the work instead of taking the work to be done to the most convenient place and where power is abundant and cheap. A point which must be borne in mind in the consideration of this question is the twofold nature of the work

FIG. 2. GENERAL VIEW OF FARM BUILDINGS.

to be done, namely, that requiring stationary machines and fixed power, and that in which the moving machines are employed, to which, if electric power is to be used, current must be transmitted through flexible cable or by a moving contact, such as that used on the trolley system of electric railroads. This point will be taken up again and fully discussed, and it is sufficient at this place to merely call attention to it and its importance in the broad consideration of this subject.

A general discussion of the advantages, financial, educational, æsthetic and otherwise, which it is considered would result from the use of electricity for farm work and in country districts in general, has already appeared in our columns.* Upon this part of the subject, therefore, it will not be necessary to continue the discussion further, but attention will be directed more especially to the practical use of electricity as adapted to the different classes of farm work. In considering a question of this character where the application of electricity to a comparatively new variety of work is taken into account there might be a tendency on the part of the advocates of electricity to overestimate its possibilities owing to the lack of familiarity with the character of the work. For this reason we have thought it best to consider the subject in connection with an individual farm as it actually exists to-day and upon which as a matter of fact electric motors are already in use for carrying on certain classes of work, and where their application on a much more extensive scale is already considered. This farm is located in one of the finest agricultural States of the West and the work is planned and carried on so admirably that it furnishes an excellent example of the possibilities of such an application of electricity. The ground plan and general view of the barns and other buildings upon this farm are shown in Figs. 1 and 2.

There are four classes of farm work to which electricity is applicable, namely, (1), for power purposes; (2), for lighting; (3), for heating purposes, and (4), for the operation of telephones, signals, alarms, etc.

The subject of power may be considered under two distinct classes. First, that applied to the stationary machines, or where the motor itself may be stationary, and, second, that furnished to moving machines or vehicles. These different kinds of work might be classed as follows:

I. *Power for stationary machines.*

(*a*) Hoisting apparatus for (1) hay, (2) grain and feed, (3) horses, cattle, etc., (4) carriages, and (5) an ordinary elevator.

(*b*) Pumping apparatus applied to (1) drinking troughs, (2) fire purposes, (3) fountains, (4) lawns, gardens, etc., (5) the dairy house, and (6) the washing of vehicles, etc.

(*c*) Miscellaneous stationary machines, such as (1) threshers, (2) grinders, (3) shellers, (4) cider presses, (5) feed cutters, (6) hay presses, (7) grindstones, (8) machine shop tools, (9) churns and coffee mills, (10) laundry machines, (11) horse cleaners, and (12) wood saws.

II. *For moving machines and vehicles.*

(*a*) Railway lines on country roads.

(*b*) Tramways connecting farm buildings.

(*c*) Miscellaneous vehicles, such as carriages and field machines of all kinds to which electricity is applicable.

Taking up the first heading of hoisting apparatus it may be said that work of this class in farm buildings is not different from similar work now carried on very extensively in other industries with electric motors as the source of power. There are, of course, differences in detail, but in general the character of the work is the same. Certain kinds of hoisting would not, however, be necessary except at certain seasons of the year, while there are other classes that would be carried on continuously day after day. The hoisting of hay, for instance, in a barn would only be necessary at a certain season, and the same might be said of the hoisting of grain of various kinds, except in cases where these materials would have to be hoisted for grinding or cutting into feed. In many barns already existing on large farms the stables and granaries are low down, either on the ground floor or on the first story, while the machines for hay and feed cutting may be placed in the second or third stories. The hoisting of horses and cattle and of carriages, or other vehicles, by means of suitably constructed elevators would, of course, only be necessary where the carriage loft or the stables are in the upper part of the barn.

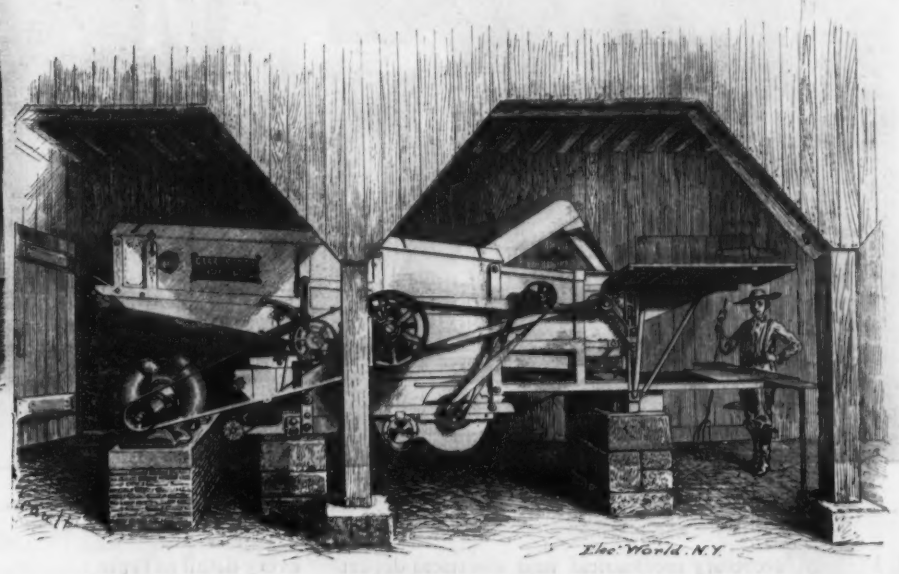


FIG. 4. AN ELECTRIC MOTOR OPERATING A THRESHER.

Work of this class, it need scarcely be pointed out, is already extensively carried on in city stables where the electric current is generally easily obtained from the street mains of different central stations; and given a suitable source of power, there is no reason whatever why similar work in large farm buildings cannot be carried on with the same success which has already attended similar installations in city stables. The ordinary elevator, either for passenger or freight service, would in large barns be found of great service and very convenient, and could well be operated by electricity in connection with other classes of hoisting.

* See THE ELECTRICAL WORLD of Aug. 6 and 20, and Sept. 10, 1892, for three articles on this subject by Wm. Nelson Black. See also an article by the same author in the *Engineering Magazine* for November.

Electricity at the World's Fair.

Work on the World's Fair grounds is progressing rapidly, and many of the buildings are being finally cleared up and decorated. A general view of the interior of the Electricity Building is shown in the large illustration on the opposite page. This will give our readers a good idea of the main features of construction, and no detailed description will be necessary in addition to what has already been given in our columns.

The engineering staff of the Fair, which has in charge the work of construction, is fully represented in the portraits shown on this page. Their names, together with their official titles, are as follows:

Frederick Sargent, Mechanical and Electrical Engineer.

Frederick Sargent, mechanical and electrical engineer.

R. H. Pierce, 1st asst. electrical engineer.

John Meaden, 1st asst. mechanical engineer.

S. G. Neiler, second assistant electrical engineer.

G. B. Foster, engineer in charge of arc lighting.

J. A. Lounsbury, engineer in charge of incandescent lighting.

G. M. Mayer, chief draughtsman electrical department.

W. S. Monroe, chief draughtsman mechanical department.

J. H. R. Ward, superintendent of electric plant.

T. P. Gaylord, electrical engineer in charge of subway,

Crawford Hutchinson, engineer in charge of erecting boiler foundations.

Luther Stieringer, consulting electrical engineer.

News was received last week from 13 foreign countries indicating that intending exhibitors abroad are taking all the space they can secure.

Luther Stieringer, Consulting Electrical Engineer.

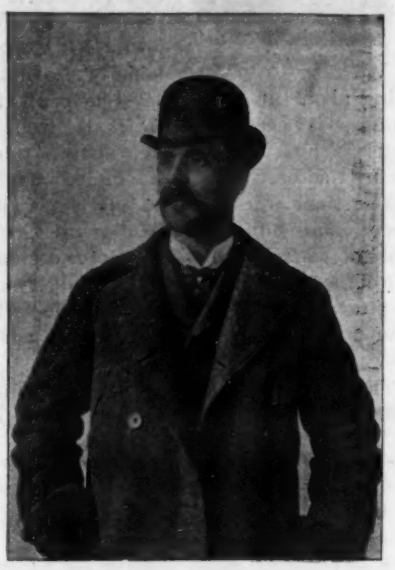
A cable dispatch was sent to all foreign commissioners and governments asking that information be sent at once as to their plans, and if possible, that lists of intending exhibitors be also sent. They were also notified that if information was not furnished immediately space previously allotted to them would be withdrawn. The Imperial Commissioner at Berlin cabled the following reply: "Exhibitors' list forwarded; our courts will be compactly filled; all space is needed. Any diminution of allotment would upset the plans upon which Germany is now prepared to participate. I protest against any reduction." Cable dispatches of a similar import were received from the Russian Imperial Commissioner, from the Swiss Government and from the Spanish Commissioner, as well as from Canada and other countries, including Norway, Denmark and Sweden. So far only four or five of the foreign governments have begun building their pavilions, among them being Germany, France, England and Japan. England's building is nearly completed, and Germany's is well under way as is also the Japanese temple.

Especial interest will centre about the grand basin east of the Administration Building, where there will be a stretch of water 300 feet wide the shores of the basin being skirted with electric lights. At its western extremity will be the two luminous electric fountains surpassing, it is said, in every detail of beauty anything that has heretofore been constructed. These will throw streams of water 150 feet high and will be illuminated with various combinations of colors. Plans for these fountains are already prepared and show many interesting and ingenious details.

Regarding the exhibit of electrical cooking appliances, a contemporary says:

"The woes of the long-suffering housekeeper are now about to vanish. The comforts of home are to be secured without any of its worries. Coal and its disagreeable effects and even the death-dealing gas are to be supplanted with electricity for the purpose of cooking as well as lighting. A steak is to be ready for the table 30 seconds after it is laid on the bar through which the electric fluid will flow. And even if it be a steak purchased by the gentle boarding-house keeper, it is warranted to be so tender, and smoking and juicy that it will tempt the veriest gourmand. It is one of the peculiarities of the cooking process that the steak, while being done to a turn, will preserve that which is lost under present conditions. Moreover, it becomes temptingly puffed, and at the touch of the knife the blessings of the new device are seen."

In the December number of *Scribner's Magazine*, F. D. Millet in an article on "The Decoration of the Exposition," has this to say regarding the decoration of the Manufactures and Liberal Arts Building: "The four grand central portals of the Manufactures and Liberal Arts Building recall triumphal arches of Roman times. Each of these portals has a lofty central entrance with rich bas-reliefs by Mr. Bitter, and smaller side arches under pendentive domes. These eight domes have been filled with figure decorations, each by a different artist. . . . In the north portal Mr. J. Carroll Beckwith has illustrated the subject of Electricity as applied to Commerce. Four female figures occupy the pendentives. The 'Telephone' and the 'Indicator' are personified by a woman



R. H. Pierce, First Assistant Electrical Engineer.

Crawford Hutchinson. L. S. Boggs. G. M. Mayer. J. Ward.
A. J. Davis. S. Bispham. O. G. Dodge. Locke Etheridge. J. A. Lounsbury. T. P. Gaylord.
Harry Jones. G. R. Green J. Meaden. S. G. Neiler. G. B. Foster. L. S. Scovil. J. F. Gray.

standing holding a telephone to her ear and surrounded by tape issuing from the ticker; 'The Arc Light' by a figure kneeling, holding aloft an arc light; 'The Morse Telegraph' by a woman in flying draperies seated at a table, upon which is the operating machine, while she reads from a book; and 'The Dynamo,' by a woman of a type of the working class, seated upon the magnet, with a revolving wheel and belt at her feet. Above, in the upper dome, is placed the 'Spirit of Electricity,' a figure of a boy at the top of the dome from which radiate rays of lightning, to which he points."

J. F. Gray, secretary mechanical and electrical department.

O. G. Dodge, inspector electrical department.

L. S. Boggs, engineer in charge electric power.

Locke Etheridge, engineer in charge of telephone and fire police signal.

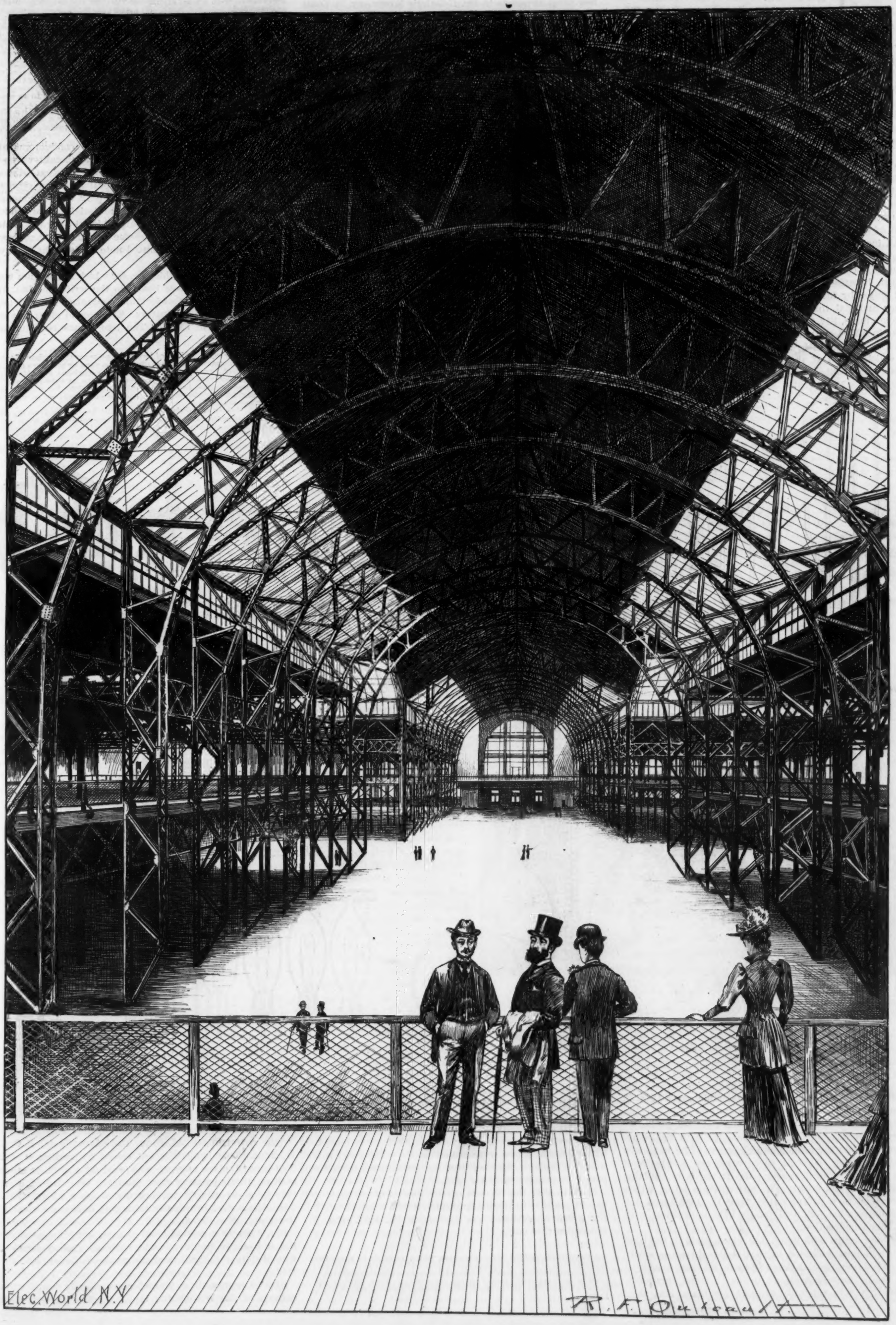
L. A. Scovil, superintendent of electric construction.

S. Bispham, engineer in charge of foundations.

A. J. Davis, engineer in charge of steam heating plants.

Harry Jones, engineerin charge of erection of machinery.

G. R. Green, inspecting engineer.



INTERIOR VIEW OF THE ELECTRICITY BUILDING, LOOKING (NORTH) FROM THE GALLERY.

Separable or Detachable Incandescent Lamps.

BY DR. L. K BÖHM.

THE advertisements of the Westinghouse Electric and Manufacturing Co., of Pittsburgh, Pa., of its new incandescent lamp, which have appeared in the leading electrical periodicals for some time, have caused a widespread interest in that lamp and lamps of its style in general, so that a short historical sketch of these lamps may be timely and interesting.

After the recent decision of the Circuit Court of Appeals in the great incandescent lamp suit, which was final and gave the controlling rights solely and exclusively to the General Electric Company as present owner of the patent in question, the other manufacturers have either to obtain the right to make lamps from the General Electric Company or they have to look for independent inventions. It is not the intention of the author to touch the legal question at all, merely the technical part of separable lamps will be reviewed.

All incandescent lamps prior to the commercial introduction of the lamp generally used at present must —broadly considered—be called separable or detachable lamps, because they consisted of more than one part not united by fusion and almost all of them had parts of other material than glass—parts of copper, wood, etc. Grove's lamp, Fig. 1 ("Phil. Mag.," 1845, p. 442), consisted of an incandescent platinum spiral connected between two thick copper wires in a cylindrical glass, the open end of which rested at the bottom of another glass vessel containing distilled water. The lamp was not exhausted. Lodyguine's lamp (1873) and Konn's lamp (1875) were

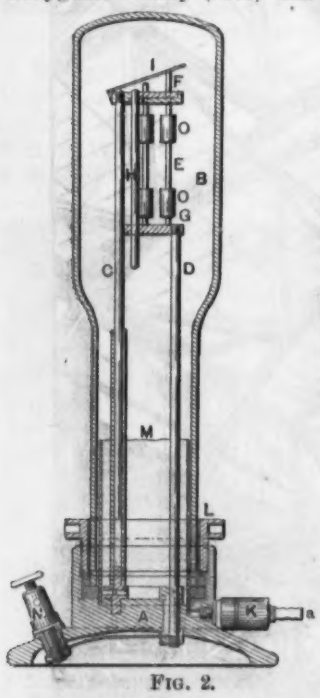


Fig. 2.

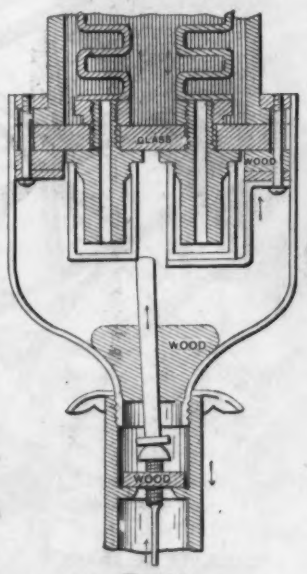


Fig. 3.

constructed with a number of detachable parts (Fig. 2, Konn's lamp), and had to be constructed so because the carbons employed did not last long and had to be replaced. The side tube, a, was connected with the piston air pump while the lamp was exhausted. The base was made of copper. Next to these came the Sawyer-Man lamp of 1878. Fig. 3 explains itself; the base contains parts of glass and wood. The Sawyer-Man lamp, which is described in a patent dated May 12, 1885, and for which application was filed Jan. 9, 1880, is identical with Fig. 3 in construction.

All these lamps with metal and wood parts in the base and conductors cemented in that base can—as is easily understood—not hold a high vacuum for any length of time, and, therefore, they never became practical, although it was generally claimed for them that they were hermetically closed. The lamp by which the problem of an airtight joint was solved was invented by the writer. The extensive experience I had with mercurial airpumps in Dr. Geissler's laboratory in Bonn on the Rhine made it easy for me to devise an airtight separable incandescent lamp. After having experienced in practice how well the ground glass stopcocks and ground glass joints on the Geissler pump kept the vacuum for any length of time, I simply applied this

Fig. 1.

principle to the incandescent lamp and consequently filed five applications for lamps and one for an apparatus for the preparation of carbon conductors. Of these five applications four were allowed and patents issued to me. The first application, which was filed Nov. 22, 1880, and contained the fundamental claims, was, however, rejected four times in succession. Fig. 4 shows the drawing of that application, which hardly needs any description. The first claim reads:

An electric lamp consisting of a separable globe or bulb A and of a base part or support B, said parts being connected by a hermetically sealed and ground joint substantially as and for that purpose set forth.

The purpose set forth in the specification is to use the globe over and over again when the filament is broken. The platinum wires were sealed in the solid glass part a of the support; they were of the usual small diameter and were consequently airtight.

Next to this the records of the patent office show a patent granted to Hiram S. Maxim, dated Sept. 13, 1881, for which application was filed April 25, 1881. Fig. 5 illustrates this lamp. The specification deals principally with:

A method of sealing wires in glass, which consists in surrounding previous to inclosing them in the glass with a mass of metallo vitreous cement composed of several layers, each one containing a greater proportion of metal in its composition than that of the layer surrounding it, substantially as and for the purpose set forth,

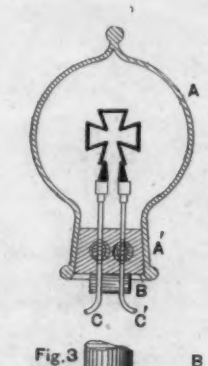


Fig. 4.

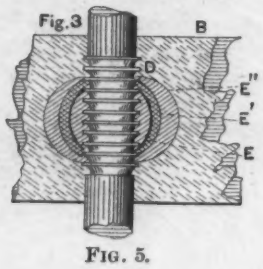


Fig. 5.

Fig. 4.

Fig. 9.

Fig. 11.

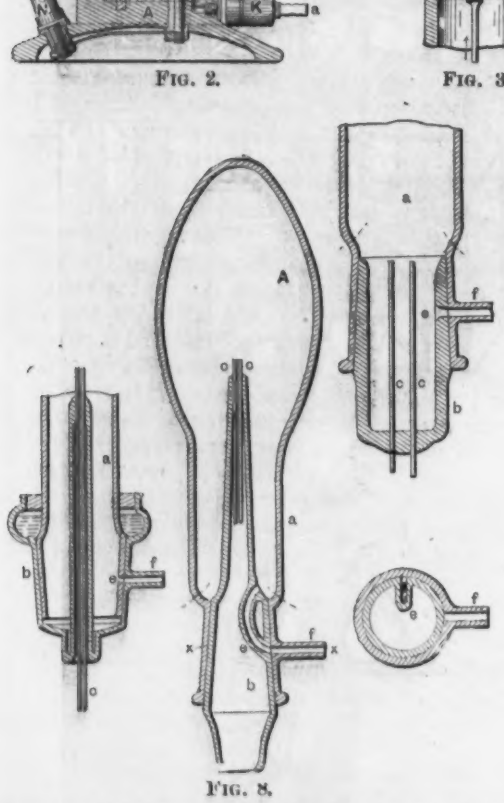


Fig. 8.

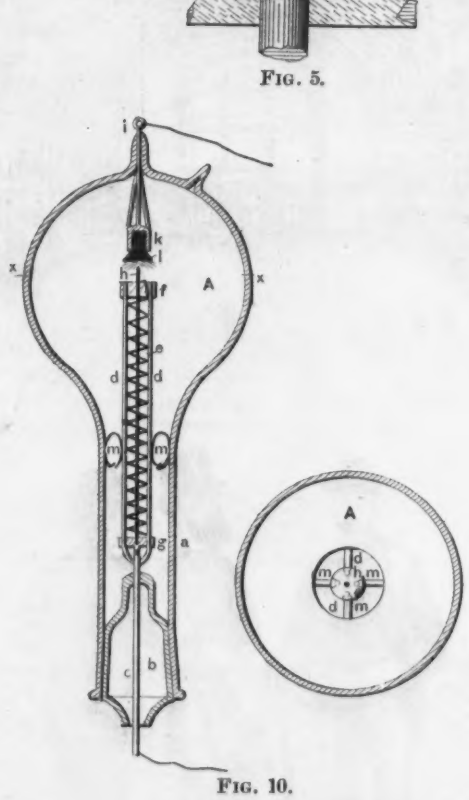


Fig. 10.

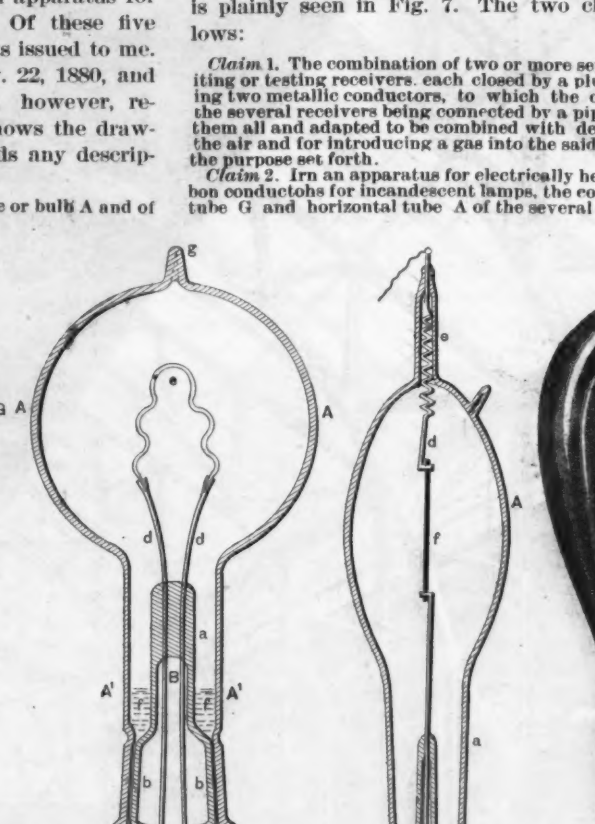


Fig. 7.

Fig. 12.

The above is the first claim. The second claim reads:

In an electric incandescent lamp, the combination with the glass inclosing globes of a ground stopper composed of a body of glass containing the conductors CC threaded or grooved as described, and surrounded with a mass of metallo-vitreous cement, substantially as described.

Now follows a patent for which application was filed May 27, 1881, by Moses G. Farmer; it is dated June 6, 1882. Fig. 6 and the two claims explain the object of that invention:

Claim 1. The method of forming a seal for the metallic conductors of an incandescent lamp, which consists in imbedding them in a plastic material, molding it to the desired shape, solidifying and hardening the same by heat, and then fitting the mass to an opening in the lamp, as set forth.

Claim 2. In an incandescent lamp, the combination, with a plug or stopper, composed of porcelain, earthenware or a similar material, of conducting wires of nickel or an alloy containing nickel imbedded in the stopper as described.

Maxim's invention of tightening the conductors into the glass by means of a problematic metallo-vitreous cement consists in a long and weary process of surrounding the conductors with several layers of cement. Farmer's porcelain or earthenware plug with conductors of nickel imbedded in a plastic material cannot hold a vacuum. The plastic material, which is hardened by heat, will, it is evident, become porous by that heating. Prof. Farmer's celebrated note book ought to have revealed that fact to him.

The next patent in this line, for which application was filed June 23, 1881, was issued to the writer on Jan. 17, 1882. It has for its object an apparatus for the preparation of carbon conductors. The ground glass stopper is plainly seen in Fig. 7. The two claims read as follows:

Claim 1. The combination of two or more separate carbon depositing or testing receivers, each closed by a plug or stopper containing two metallic conductors, to which the carbons are attached; the several receivers being connected by a pipe or tube common to them all and adapted to be combined with devices for exhausting the air and for introducing a gas into the said receivers as and for the purpose set forth.

Claim 2. Irn an apparatus for electrically heating and testing carbon conductohs for incandescent lamps, the combination, with main tube G and horizontal tube A of the several bulbs B B, closed by plugs or stoppers containing the conducting wires D D carrying clamps for retaining the ends of carbon conductors as and for the purposes described.

Following this came the application filed July 6, 1881, by the writer and E. M. Fox. The patent is dated Oct. 11, 1881. This lamp was not closed by sealing it off. The ground glass stopper was used like a glass stopcock on an air pump to close the lamp after it had been exhausted by simply turning the stopper about 180°. The claims deal principally with this device for closing the lamp. (See Fig. 8).

Fig. 9 shows a ground glass stopper lamp invented by the writer. It had a straight carbon. The application was filed July 15, 1881, and the patent is dated Nov. 29, 1881.

Fig. 10 represents a ground glass stopper lamp with carbons of the Wiedemann type. Application was filed

by the author July 15, 1881, and the patent is dated Nov. 29, 1881. Quite recently F. S. Smith, of Pittsburgh, Pa., had a patent issued to him on Oct. 25, 1892. The application was filed on Feb. 29, 1892. It is for "an incandescent lamp consisting of a filament and an inclosing chamber consisting in part of glass and in part of a soluble substance." How well a "soluble substance" through which the wires pass will hold a vacuum remains to be seen.

The well advertised new lamp of the Westinghouse company is represented in Fig. 11, and Fig. 12 is a cut of the ground stopper. Such a lamp was shown to me at my office. The advertisements say that the lamp does

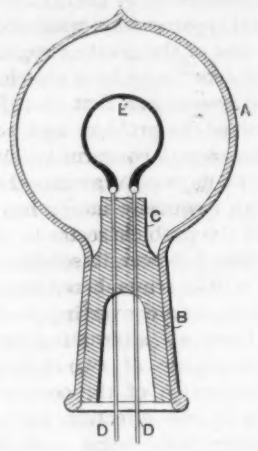


FIG. 6.

not infringe the Edison nor any patent of other companies, but is fully covered by patents of their own. It is further said that it requires no platinum and is made in separable parts. It is said that the leading-in wires are made of an alloy which is claimed to be a satisfactory substitute for platinum. As these features are covered by patents owned by the Westinghouse company, according to the advertisement, they must have reference to the patents granted to Farmer and Maxim and to me, which were described above and are shown in Fig. 5, etc. Maxim's method of sealing wires into a solid glass plug by means of a metallo-vitreous cement and Farmer's porcelain and earthenware plug, with conductors imbedded in a plastic material which is solidified by heat, leaving that plastic material in a porous condition, are very likely not taken seriously by any electrician in our day. The plug of the new Westinghouse lamp shown to me was apparently not made with conductors imbedded in plastic material or covered by a metallo-vitreous cement; the rather heavy leading-in conductors seem to be simply pressed into the solid glass plug which is shown in Fig. 12, and is of the same shape as the plug in my lamp shown in Fig. 4, the difference being that my plug is hollow and has thin platinum wires sealed in at the top of the plug, while the rather heavy conductors in the new Westinghouse lamp, said to be of an alloy, are surrounded by glass for the whole length of the plug. In my opinion, however, heavy conductors of a material other than platinum will not prove airtight in the long run. As the date of the introduction of the new lamp is so near—it is stated in the advertisements on and after Dec. 1—we will soon have a chance to see whether lamps with heavy conductors of an alloy will hold the vacuum when pressed in a solid glass plug. As stated, I doubt it very much.

I have described that my application filed Nov. 22, 1880, was rejected four times in succession, and that Maxim filed an application April 25, 1881. He had his patent granted and it is dated Sept. 13, 1881. This was before any of my other patents with stoppers were issued. The first of mine issued was that of Oct. 11, 1881, to E. M. Fox and muyself as oint inventors (see Fig. 8). Maxim has in the second claim the combination, with the glass inclosing globe, of a ground glass stopper. I had in my first claim: "An electric lamp consisting of a separable globe or bulb, A, and of a base part or support B, said parts being connected by a hermetically sealed and ground joint." The ground joint is mentioned in the claims of both applications and I do not know why an interference was not declared. My application was filed about five months before Maxim filed his, and while Maxim filed his I was with the United States company and constructed about that time the apparatus for the preparation of carbon conductors, Fig. 7.

It must, however, be considered that only inventors and electricians were in 1880 and 1881 fully conversant with the state of the art of incandescent lighting; the general public and perhaps the examiners knew at that time less about it than to-day, and if, at that time, an application for a patentable feature was rejected the Patent Office ought to correct this by granting a patent to the inventor now, if applied for, because that lamp has not so far been in practical use—it will be put on the market on and after Dec. 1—and because the ground glass stopper is the feature in that lamp which distinguishes it in principle from the Edison lamp. The other feature of the lamp, viz., the rather heavy conductors of a material, not platinum, pressed into the solid stopper, is a matter of serious doubt. They will, in my opinion, not hold the vacuum for the required length of time.

The Ground Return.

In the course of the discussion at the recent meeting of the American Street Railway Association at Cleveland Mr F. S. Pearson, chief of the steam and electrical department of the West End Street Railway Company of Boston, brought up some points in reference to the ground return which, from his long experience in this line, should prove of interest to practical men.

In small towns and systems where there are few cars running, Mr. Pearson thinks the ordinary method of returning the current through the rails and supplementary wire is sufficient unless the distance is great. On large roads where the traffic is heavy, more return grounds than have been used heretofore will have to be installed. It was found so in Boston, and from lack of return feeders a great deal of electrolytic action was caused in the supplementary wire, and the West End company is now putting up a large amount of overhead copper for return grounds, since the underground will corrode and rust away. There is no advantage in using iron, as the conductivity is only one-seventh that of copper. Originally the positive current was run through the trolley wire, but it was found that the action on the supplementary wires was too great, and so the negative was put to the trolley wire. It was not thought that there would be much less effect, as it merely transfers the action to another point.

In reference to water pipes Mr. Pearson said that he did not have in mind any particular trouble with water pipes, but naturally, if there is a large volume of current going through the earth, it will take hold of a water pipe or a gas pipe, or any other pipe, and there will be an electrolytic action set up; and in any large railway system, if the attempt is made to use the earth for return ground by putting in ground plates in driven wells, or by putting them in the rivers, and the return current is not provided with a good metallic circuit, the current must inevitably injure the water pipes and all other pipes. The current, when it leaves the car, goes into the ground, and, taking a water pipe, may go a mile on that pipe, then leave it for a better conductor, the result being that the pipe will be corroded at this latter point.

As to using old rails for a return the difficulty is to make a good joint. If the rails could be welded or soldered this plan might work, but the joints could hardly be made in any other way so that they would carry the large volume of current without heating or corrosion. To joint the rails by copper plates would be a poor construction, as the iron and copper would form an electrolytic element and cause corrosion, even if no current was passed through the joint The passage of the current would also heat the joint and cause further oxidation.

In the early days of electric railroading an attempt was made to use the rail for a return current and not put in supplementary wires. but it was found almost impossible to maintain a joint of any sort. When a large volume of current is sent through the joint oxidation takes place, and the joint soon becomes worthless. This condition will exist no matter how large the joint is made, and if dissimilar materials or metals are used a local electrolytic action will also take place. With steel in contact with iron the effect will be produced in a lesser degree than with copper, and it will take longer for the trouble to develop.

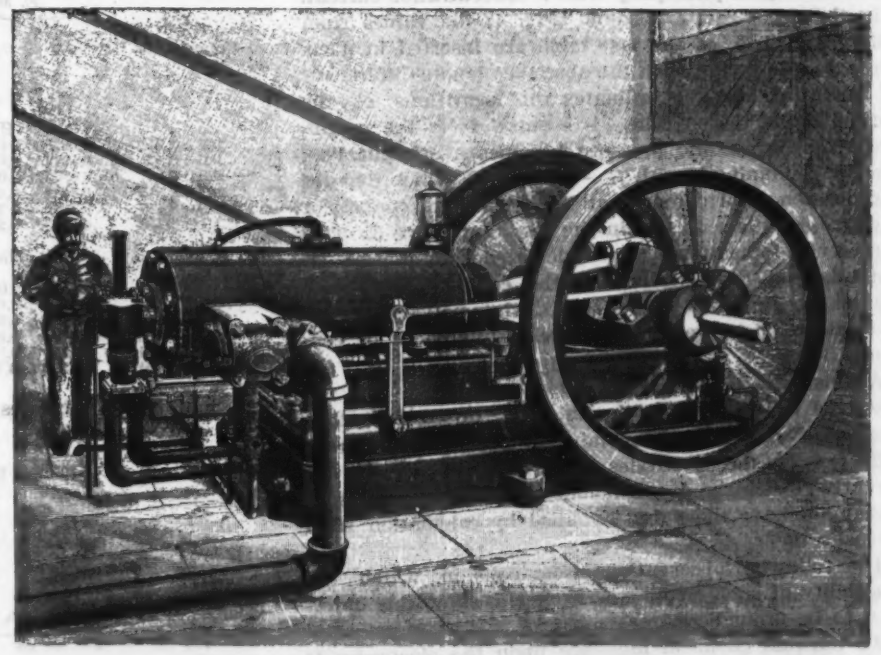
Old steel and iron cables had been used in the crossing of rivers and for connecting the supplementary wires from one side of the track to the other, but the objection to the cable is that it cuts away very fast. For instance, in one place seven ropes or cables had been put in and soldered thoroughly at each end, and in less than four months they were entirely gone. If the soil was comparatively dry and sandy this scheme might do for a while, but where it is moist and solid it is a question whether the cables will last long enough to pay for putting them down. As a rule in track construction to-day the West End road uses supplementary wires as well as bond wires on the rails, the former having a low resistance as compared with the bond wires and joints. The greater current passes on the supplementary wire and does not go through the joint. If the supplementary wire is cut and all the current is made to pass through the bond wire there is trouble, but as long as a good supplementary conductor is maintained the current will not pass through the bonded wire, the joints will remain cool and there will be no great tendency to oxidation, especially if tinned rivets are used.

Boston Car Fender.

To properly describe this fender it is advisable to divide its construction into two parts, the frame and the drop. The frame is made of hardwood boards bolted into metal sockets and is intended to be fastened to a car under the platform or in front of the wheels on the frame of the truck, and to extend down within about four inches of the rails. There are three metal sockets, one in front and one in each of the wings (V-shape) of the frame at the rear end and directly over each rail Each socket is partly divided by a vertical slot about three inches long through which the hangers of the drop operate. The drop consists of three hangers and four guard rollers and has a rise of three inches or more. It is connected to the frame by bolts that pass through the hangers and slots back of the frame, where they are made secure. The end hangers are about four inches wide and ride the rails or near to them, and the rollers run nearly as low as the hangers, and never rise when pushing an object off the track on account of the resistance of the object. They are made of metal, are hollow and revolve on nipples about two inches long that extend from the sides of the hangers. The nipples are small enough to allow the rollers to rise and fall at each end, with a corresponding rise at the other end at the same time. By this action the drop is easily adjusted to the conditions of the roadbed. The exposed side of the fender is comparatively smooth, free from rough nuts, bolts or sharp points to catch clothing, or puncture the flesh. The drop operates in front or outside of the frame and the space between is ample to allow dry snow and dirt to escape without friction. This fender works automatically, is always on duty when the car is in motion, is simple to construct, durable and cheap, and should command the attention of street railroad managers.

A Large Gas Engine.

The gas engine shown in the accompanying illustration is manufactured by H. W. Caldwell & Son, of Chicago, Ill., and now in use in the large grain elevator of Taylor Brothers, Cooper's Point, Camden, N. J. This engine is rated at 100 h. p. It is operated by carbureted air, consisting of a mixture of common air and gasoline vapor. This provides a fuel which is not only invariable in quality, but is quite inexpensive. In large quantities the gasoline costs six cents per gallon in large cities, and as this engine is operated by one gallon of 74 degrees gravity gasoline per horse in 10 hours, it will be seen that the cost of fuel is very light compared with the power yielded. As the engine is working at present it is developing 62 h. p. actual. The cylinder has a bore of 16¼ inches and the stroke is 24 inches. The crank shaft has a speed of 150 revolutions per minute. The gasoline is drawn directly from a tank considerably lower than the engine, and its vapor is mingled with the air without any special carbureting device. The governor limits the number of charges admitted to the cylinder by controlling an air gate over one of a pair of air tubes shown at the rear of the engine. The air gate has two ports, and allows air to be drawn through either



A 100-HORSE POWER GAS ENGINE.

tube according to the action of the governor. In one tube there is a nozzle leading upward from a reservoir containing less than a pint of gasoline, and when the port above this tube is opened the engine takes in an explosive charge the charges are ignited by an incandescent tube incased in a larger tube lined with asbestos. As this engine requires no fireman or skilled engineer, and as it uses cheap fuel which leaves no residue, it is apparent that it has grea advantages over the steam engine. The credit of the invention of this engine is due to Mr. James A. Charter, who has long been known in the gas engine business.

Hot Water Coils Heated by Electricity.

The first practical use of electricity to heat hot water coils. the inventor claims, was made last week, when R. A. McCormack, of Ottawa, Ont., installed the Ahearn electric heaters in his store. The switch was turned on at 6:30, the temperature was then 50 degrees, in 20 minutes the cold was out of the pipes, and at 9 o'clock the temperature had risen to 68 degrees. The water for the coils is contained in five heaters in the cellar, the total capacity being about 23 gallons. By having five separate heaters the heat and expense can thus be regulated.

Experimental Studies of the Differences of Potential Generated Through Contact of Metals, Liquids and Dry Electrolytes.—II.*

BY WALTER NEGBAUR, PH. D.

The measurements on some cells which verify the general case are given in detail in the following tables. The first column gives the concentrations used, the second the differences of potential, calculated by Planck's theory, the third the same quantity corrected for the degree of dissociation. The fourth column contains the corrected osmotic pressure calculated according to Nernst. The fifth column gives the sums of the values of columns three and four, the last finally gives the observed E. M. Fs. of the cells. The positive current flows in general from the first named solution to the second; in the contrary cases the value is preceded by a —.

The agreement between theory and experience is very good. It can be seen from the tables that the difference of the kathions of the two solutions occurs principally in the vicinity of the concentration ratio 1, but with increasing difference of concentration the velocity of the ions is no longer decisive, but their number; we therefore are concerned again principally with a concentration current.

	Concentrations.	$\frac{R}{E}\cdot \lg \xi$	The same value corr.	Osmos press., corr.	E. M. Fs. Calculated.	E. M. Fs. Observed.
LiCl HCl	0.001 : 0.1	0.04523	0.0452	— 0.1160	— 0.0708	— 0.0725
	0.01 : 0.1	0.03074	0.0307	— 0.0564	— 0.0257	— 0.0222
	0.1 : 0.1	0.0358	.....	.....	0.0358	0.0352
	0.1 : 0.05	0.04126	0.0411	0.0196	0.0607	0.0581
	0 1 : 0.02	0.05012	0.0501	0.0410	0 0911	0.1905
	0.1 : 0.01	0.05743	0.05801	0.0582	0.1162	0.1181
	0.1 : 0.002	0.09808	0.0981	0 0975	0.1956	0.1900
	0.1 : 0.001	0.1154	0.1140	0.1142	0 2282	0.2209
	0.1 : 0.0001	0 1731	0.1710	0.1701	0.3410	0.3208
	1.0 : 0.0001	0.2308	0.2300	0.2260	0.4560	0.4120
NaCl HCl.	0.1 : 0.1	0.0334	.....	.....	0.0334	0.0330
	0.1 : 0.05	0 039305	0.0398	0.0182	0.0580	0.0572
	0.1 : 0.02	0 048465	0.0485	0 0400	0.0885	0.0871
	0.1 : 0.01	0.0565	0 0575	0.0570	0.1155	0.1169
	0.1 : 0.002	0.09802	0.0980	0.0975	0.1955	0.1820
	0 1 : 0.001	0.1152	0 1142	0.1102	0.2244	0.2190
	0.1 : 0.0001	0.1729	0.1700	0 1706	0 3406	0.3285
	1.0 : 0.0001	0.2307	0.2300	0.2260	0.4560	0.4000
LiCl NaCl.....	0 001 : 0.1	0.04440	0.0444	— 0.1132	— 0.0688	— 0.0655
	0.01 : 0.1	0.02110	0.0211	— 0.0564	— 0.0353	— 0.0350
	0.1 : 0 1	0.0024	0.0026	.....	0.0026	0.0024
	0.1 : 0.01	— 0.01436	— 0.0150	0.0580	0.0430	0.0418
	0.1 : 0.002	— 0.02506	— 0.0251	0.0989	0.0738	0.0752
	0.1 : 0 001	— 0.02966	— 0.0297	0.1154	0.0857	0.0824
	0.1 : 0.0001	— 0.04427	— 0.0442	0.1698	0.1256	0.1120
LiCl KCl.....	0.001 : 0.1	0.04450	0.0451	— 0.1150	— 0.0699	— 0 0722
	0.01 : 0.1	0 02344	0.0224	— 0.0570	— 0.0346	— 0.0350
	0.1 : 0.1	0.0077	0 0072	.....	0.0072	0.0075
	0.1 : 0.01	0.00063	0.0006	0.0577	0.0583	0.0574
	0.1 : 0.002	— 0.001365	— 0.0014	0.0970	0.0956	0 0920
	0.1 : 0.001	— 0.00187	— 0.0019	0.1140	0 1121	0.1102
	0.1 : 0.0001	— 0.00323	— 0.0032	0.1710	0.1678	0.1520

Against the correctness of this explanation of the observed values the objection might be raised, first, that chemically different end members might have different influence on the electrodes. Further, that with differently concentrated end members the osmotic pressure might not have the value obtained by calculation from Nernst's theory.

The following observations from cells in which the possibility of such errors was excluded show this objection to be groundless.

An unequal chemical influence upon the electrodes is excluded with cells of the form:

Combinations:	E. M. Fs. Calculated.	E. M. Fs. Observed.
0.1 KCl | 0.01 LiCl | 0.001 KCl	0.1384	0.1230
0.1 KCl | 0.1 HNO_3 | 0.001 KCl	0.2004	0.1790
0.1 LiCl | 0.1 HNO_3 | 0.001 LiCl	0.1918	0.1900
0.1 NaCl | 0.1 HNO_3 | 0.001 KNO_3 | 0 001 NaCl	0.2011	0.1820

The influence of different concentration is avoided in the following cells:

Combinations:	E. M. Fs. Calculated.	E. M. Fs. Observed.
0.1 KCl | 0.01 LiCl | 0.1 NaCl	0.0138	0.0132
0.1 HCl | 0.001 LiCl | 0.1 NaCl	0.1437	0.1444
0.001 KCl | 0.1 HNO_3 | 0.000 LiCl	0 0000	0.0011
0.01 HCl | 0.1 KNO_3 | 0.01 NaCl	0.0129	0.0122
0.01 HCl | 0.1 $KClO_3$ | 0.01 NaCl	0.0179	0.0161

*Based upon papers published in "Wiedmann's Annalen," 1891 and 1892.

Finally a few cells with identical end members, which, therefore, give values independent of the electrodes:

Combinations:	E. M. Fs. Calculated.	E. M. Fs. Observed.
0.1 KCl | 0.1 NaCl | 0.001 LiCl | 0.1 KCl	0.0018	0.0010
0.1 KCl | 0.1 HCl | 0.01 LiCl | 0.1 KCl	0.0286	0·0311
0.1 LiCl | 0.1 HNO_3 | 0.001 LiCl | 0.1 LiCl	0.1192	0.0984
0.01 NaCl | 0.01 HCl | 0.1 KNO_3 | 0.01 NaCl	0.0101	0.0200
0.01 NaCl | 0.1 $KClO_3$ | 0.1 KNO_3 | 0.01 NaCl	0.0063	0 0059
0.001 LiCl | 0.001 KNO_3 | 0.1 HNO_3 | 0.001 LiCl	0.0090	0.0059
0.001 KCl | 0.1 HCl | 0.001 LiCl | 0.001 KCl	0.0037	0.0029
0.01 HCl | 0.1 $KClO_3$ | 0.1 KNO_3 | 0.01 HCl	0.0013	0.0002

Special cases. 1. Concentration cells. The positive current goes, in accordance with theory, from the concentrated to the dilute solution.

Concentrat.	E. M. Fs. Calcul.	E. M. Fs. Corr.	E. M. Fs. Observed.	E. M. Fs. Calcul.	E. M. Fs. Corr.	E. M. Fs. Observed.
	HCl			KCl		
0.1 : 0.05	0.0289	0 0286	0.0272	0.0169	0.0166	0.0165
0.1 : 0.02	0.0672	0.0662	0 1660	0.0395	0.0384	0 0390
0.1 : 0.01	0 0960	0.0935	0.09 6	0.0565	0.0542	0.0535
0.1 : 0. 02	0.1628	0.1592	0.1592	0.0960	0.0931	0.0918
0.1 : 0.001	0.1920	0 1880	0 1820	0.1130	0.1070	0.1090
1.0 : 0.001	0.2880	0.2620	0.2390	0.1695	0.1460	0.1250
	NaCl			LiCl		
0.1 : 0.05	0.0129	0.0127	0.0130	0.0107	0.0105	0.0100
0.1 : 0 02	0.0310	0.0292	0.0290	0.0249	0.0244	0 0255
0.1 : 0.01	0.0429	0.0109	0.0405	0 0356	0.0340	0.0345
0.1 : 0.002	0.0729	0.0701	0.0686	0 0906	0.0582	0.0566
0.1 : 0.001	0.0858	0.0818	0.0785	0.0712	0 0663	0.0636
1.0 : 0.001	0.1287	0.1086	0.0998	0.1068	0.0861	0.0845

2. Solutions of mixtures of salts. A normal solution in which the dissolved equivalent parts of NaCl and LiCl are 8 : 2, may be arranged in opposition to a second normal solution, in which 5 equivalent parts of NaCl and 5 parts of LiCl are dissolved. For this cell:

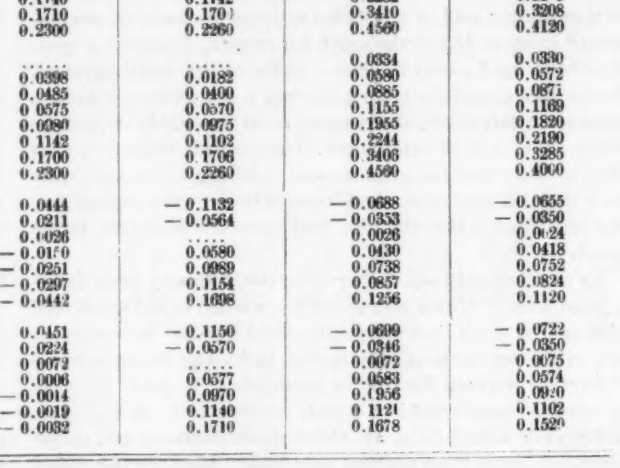


Fig. 4.

$$1.0 \left\{ \begin{matrix} C\ NaCl \\ C_2\ LiCl \end{matrix} \right| \left. \begin{matrix} C_1 NaCl \\ C_4\ LiCl \end{matrix} \right\} 1.0$$

in which all members have an equal anion, the difference of potential is determined from the equation:

$$\varphi_2 - \varphi_1 = \frac{R}{\varepsilon} \cdot \lg \frac{u_1 c_1 + u_2 c_2 + v}{v + u_2 + c_3 (u_1 - u_2)}.$$

For the example cited above, calculation gave 0.00074 volt, and observation in one case 0.1, and in a second 0.4 milli-volt, which, considering the smallness of the forces, is a satisfactory agreement.

(To be continued.)

Electrical Needs of the Times.—I.

BY H. FRANKLIN WATTS.

The adage that electricity is in its infancy is fast becoming something of a "chestnut." If indeed it is still an infant in years we may say in all sincerity it is a man in experience and strength and wears a long beard.

As in the modern application of electricity it is the young men that stand foremost in every department and practically control the electrical forces of the world, so, also, we may say that

> "The infant which Ben Franklin with his kite has given birth,
> Now surprises with its wonders all the nations of the earth."

The electrical transmission of energy over great distances to fulfill commercial requirements with safety and economy may be said to be one of the greatest engineering problems with which engineers have been associated. When the alternating current system was first brought out it at once claimed to have solved the problem and possibly has done so, so far as distance alone is concerned: but the alternating arc lamp is to-day no more of a favorite than ever, and the long promised high frequency motor has not been forthcoming. All in all the problem seems as far from solution as ever. At one time, however, its solution was apparently within reach. It will be remembered that at one time Mr. Nikola Tesla brought out a converting device for obtaining a direct current from an alternating circuit. This consisted of an arrangement of two or more transformers, whereby the self-induction of the converters produced a stoppage of current in one direction and a double flow in the other, the connections being such that the practical effect was to deliver to a local circuit a direct current suitable for arc lamps and electrolytic operations. Engineers far and near at once became interested, for it was self-evident that the invention promised great results. These results have been disappointing in the extreme. The invention has never been placed upon the market, and by many the affair has been entirely forgotten.

Consider what would be the result of such an invention. Suppose we have an efficient converting device, which, when placed upon an ordinary 16,000 or 14,000 alternation lighting circuit, will deliver to a local circuit a direct current of any desired voltage, or current up to the capacity of the generating dynamo. Would such a device not work a revolution in our central stations? Would it not at once remove the necessity for arc machines altogether? Would not the regular alternating machines that are now running in all of our principal stations be able to satisfy all possible conditions of service, arc, incandescent, power, the charging of storage batteries, and the electro decomposition of metals? Could we not accomplish all of this over great distances with safety and economy? In short, would the problem above referred to not be practically solved? Evidently, then, this is one of the greatest needs of the fraternity to-day. Granting all this, what next?

We want alternating machines to run in multiple as a regular thing. All of the manufacturers will at once tell you that their machines can be run in multiple, but the fact remains that not one of these companies is doing so in practice—chiefly due to the difficulty in obtaining and maintaining synchronism, due in turn to the high frequency which will be referred to later on. The direct current advocates have been over zealous in showing the need and advantages to be obtained by so doing, while our "crooked current" friends have made every effort to prove that multiple arcing is entirely unnecessary and is not carried out in any central station in the United States to-day. The alternating station managers will also tell you that the present system of running each machine upon a separate circuit is satisfactory, for even in changing over the lights on any one circuit are out but an instant. Of course this is very true, but it is not all of it. Although they are out but an instant, which is alone very undesirable, the lights fluctuate in candle power either up or down, and remain so until the attendant has had time to regulate the voltage. It is practically impossible to so regulate the voltage of a machine in advance that this will not take place. Of course, accurate compounding ought to correct this, but the writer knows of no machine which will prevent it. Again, the horse power transferred from one machine to another in the act of throwing one switch is often very great, and a change of speed invariably follows, which no amount of compounding can correct.

In the direct current system it is impossible to raise the voltage of any feeder above that of the bus rods in the station. The voltage of one side of a three-wire feeder can be raised by means of the equalizing, but this is at the expense of the other side of the same feeder. Hence it is no total increase of voltage, but is on the other hand a great waste of power. The equalizer is rapidly going out of use. If now the above dynamos (direct current machines) were operated upon separate circuits, similar to alternating machines, how readily could the voltage of any feeder be raised or lowered independently. Here, then, is a feature in favor of direct current machines being run upon separate circuits instead of in multiple. On the other hand, if alternating dynamos are running in multiple and supplying a constant voltage to a set of bus wires, it is a very simple matter to raise the voltage of any particular feeder to any point desired, even to double the voltage of the mains that feed it, if necessary. In the Westinghouse system the Stilwell regulator is regularly employed for this purpose. It raises the voltage of any feeder to any amount above that of the main bus wires—say, from 2 to 10 per cent.

This is an excellent feature and scores many votes in favor of multiple arcing alternators, and, furthermore, the device is of the highest efficiency and has no moving parts.

While giving due credit to both sides of this question and taking as unbiased a view as possible, the conclusion forces itself upon us that multiple arcing is very desirable and must ultimately become one of the essential requirements of central station practice.

To accomplish multiple arcing we must choose an armature having a large self-induction, so that a short circuit will not injure the armature—that is, the self induction will hold back the current within reasonable limits. The present tendency is to build alternating machines with slotted armatures and containing a large amount of iron. Such an armature if short circuited close to the machine and getting its full field from an independent engine, will generate about five or six times its maximum current and drop its voltage to about the same ratio; hence, the horse power is not increased, and as this current continues only until the fuses blow, no harm results; hence, it is such an armature as this that we should use in attempting to multiple arc alternators.

At one time, before the slotted armature came into use and when a short circuit usually resulted in a burnout, the writer attempted to produce a reactive converting device to be connected in the main circuit of the alternator to hold back by self-induction the heavy momentary current during a short circuit, and thus act in advance of the safety fuses. The use of the slotted armature, however, rendered such a device unnecessary, as the armature itself contains the necessary reactive principle.

The next consideration is the frequency, and it is upon this point that the writer wishes to draw special attention. While dynamos are operated at 14,000 to 16,000 alternations per minute, and are belt driven, they will never be connected in multiple. We may as well accept this fact at once. This is the principal difficulty to day in so doing. What then is the reason that the frequency cannot be greatly reduced—say to one-fourth of its present rate? Without answering this too hastily, let us consider what would be the result from so great a reduction in frequency. Suppose alternating machines had not yet come into use, and were entirely unknown and the principles of self-induction, as developed in the transformer, and its consequent self-regulating features, were unknown, and that a corp of engineers experienced in the designing of direct current machines for all purposes had decided to develop an alternating system to operate entirely by means of converters, what type of dynamo would be produced and how high a frequency would be decided upon? Would not a frequency of 15,000 alternations per minute seem needlessly high? Being familiar with the "time constant" of large magnets, or the time required to fully magnetize them, and the high efficiency of large magnets over small ones, and the great objection to high speeds, would not these engineers decide upon a frequency as low as will not permit an incandescent filament to cool off between each alternation? In the minds of these men, what possible reason could there be for proposing an alternation rate higher than—say from 10 to 50 per second, to say nothing of 275 to 300? In the minds of these men, would there be any advantages to be obtained by a higher frequency? Not the slightest. Of course, in the light of modern experience with the alternating system, it will be asserted that while a frequency of 27 alternations per minute might give a continuous light in the secondary, there will be no such thing as regulation, as self-induction will be practically eliminated by the sluggish frequency. This is, without doubt, the only consideration tending to high frequencies, or the only good and solid ground that can be taken in their favor. With this knowledge before them, the above engineers would immediately raise the frequency from perhaps 200 to 5,000, but it is entirely unlikely that they would decide upon a frequency of 15,000. It has been found that a converter can be constructed to operate equally well at 16,000 or 7,200 alternations. Who is able to assert that a specially constructed converter containing a large amount of iron worked at a frequency of from 40 to 70 reversals per second will not give good regulation and have an "all day" efficiency greater than the present ones? All theoretical considerations are in favor of lower frequency. At all events, we must reduce these terrific speeds.

Everywhere these alternating systems are employed you will find machines having from 8 to 16 magnets crowded together into a small space, an armature whose periphery is traveling at the rate of from 5,000 to 8,000 feet per minute, driven by belts running 7,000 feet per minute or over, and driven by an engine running at its highest speed and having a special pulley as large as they dare to put on, and on the dynamo as small a pulley as can be made to drive, and a belt like a fiddle string. Special pulleys on engine and dynamo, special speeds, in fact, everything special. And all for what purpose? Simply to obtain a frequency of 16,000. By the side of the machines running at these high speeds will be found direct current machines running at consistent and sensible speed. Close by an alternator requiring 80 h. p., having an armature 15 inches in diameter and running 2,000 revolutions per minute in an eight-pole field driven by a 9 inch pulley, is an arc machine requiring 30 h. p., having an armature 22 inches in diameter and running at 800 with a 16 inch pulley. In the same station will be found another alternator absorbing 150 h. p., whose armature is 18 inches in diameter, running at 1,650 revolutions in a 10 pole field driven by a 16-inch pulley. Further on is a railroad generator having an armature 16 inches in diameter, running 600 to 700 and absorbing 88 to 100 h. p., with a 20 inch pulley. Can any one doubt which of the above arrangements gives the best results in practice? Which runs coolest, the direct or alternating? Which has the coolest bearings, which has the loosest belts, which engine runs the quieter and which engine breaks down first, or is most liable to? In certain stations operating at 14,000 the speeds and sizes of pulley are somewhat better than the above, but they are too high even here. Where can you find an alternator in the United States having a driving pulley longer and broader than the armature? There are many direct current machines so proportioned—shunt machines and railroad generators. Why cannot we have the same on alternators?

We have always been taught to believe that an alternator is necessarily a high speed machine. But why is this true? Is there any true, honest and logical reason why alternators cannot be run at the same rate of speed as Edison's shunt machines, for example?

Does it require a larger, heavier and more expensive converter at the above low frequencies per unit of output? The converter might, perhaps, contain more iron, as it undoubtedly would—and yes, more copper also; but even assuming the cost of the converters to be increased by the low frequency, even this will not necessarily offset the advantages at the station attending low belt speeds, large pulleys, cool bearings, loose belts, etc.

Apparently no experiments have ever been made at any such low frequency to determine this and many other considerations. We want somebody to do for low frequency what Tesla and Thomson have done for high frequency.

(To be continued.)

Series Electric Traction; a Reply to Dr. Cary T. Hutchinson.

BY NELSON W. PERRY.

Dr. Cary T. Hutchinson, in his criticism of my paper on "Series Electric Traction," at the recent meeting of the American Institute of Electrical Engineers, whose remarks were published in THE ELECTRICAL WORLD of Nov. 19, labored so palpably under a total misapprehension of what my system really is, that I beg leave to set him right on the more vital points raised.

I regret his criticism of my paper less than the fact that he should have made its discussion a fence from behind which to make an uncalled for attack upon another in no way connected with me, my invention, or my description thereof.

Dr. Hutchinson's doctrine seems to be that because a prior worker in this field confessedly failed, all subsequent workers in this field must of necessity find it unprofitable, and that the Institute was therefore wasting its time in listening to the results of their labors.

If Dr. Hutchinson's doctrine were true, and always held in times past, the world would have stood still and no progress have been made, for it has been truly said that "success has always been built upon failure," and that "failure is oftentimes more instructive than success."

I do not hold Dr. Hutchinson's doctrine, and therefore, notwithstanding the fact that an earlier worker in this field made failures, and that having worked with those failures myself, and personally familiar with them, notwithstanding this fact, or rather because of it, I attempted to correct many of his errors and to achieve success by an entirely different method.

After agreeing with me that my series system "works beautifully on paper," Dr. Hutchinson adds that "it will never work anywhere but on paper," "for," he says, "some kind of movable switches must be used, with magnets to open and close them, with two circuits on the magnets."

I admit this freely, but if movable switches must be condemned, then must we condemn all the commutators and brushes, and therefore our dynamos and motors. If movable switches opened or closed by electromagnets are an offense, then must we reject many of the best known and most efficient regulating devices. We must condemn Thomson's method of automatic regulation of the brushes on the T-H. arc machine. We must condemn the Brush dial regulator, and we must condemn the arc lamp itself.

If a magnet wound with two circuits is a crime, then the best instruments used in multiple telegraphy are wicked, all compound wound dynamos are guilty, and what criminals Frank J. Sprague and his able accomplice Dr. Hutchinson must be for building motors with three?

The next weakness he discovers is, "Trolley wheels have to run on and connect three wires at the same time in many cases, making contact with all of them, and I can say the whole thing is absolutely impracticable."

But what if I only claim that the three wires, which in my system are only a few inches or a foot long, and placed at very considerable intervals, only need to be electrically connected as the trolley passes by? That is all I ever claimed or thought of, and never said that the trolley *wheel* should run on any or all three. I used the word *trolley*, not trolley *wheel*. Dr. Hutchinson is probably excusable to a certain extent for his assumption, from an examination of the diagrams, but he must remember that they are merely diagrammatic. He misquotes me here and condemns my system on a feature I never claimed.

Next he says:

"In using a constant current, one must vary the potential difference at the car; a car which would take 100 ampères at 500 volts, as many do, will, if run on 40 ampères, require 1,250 volts."

This is very true, and he might have further added that if the same car ran on 10 ampères, it would require 5,000 volts and his argument would have been stronger. Bu one would be very foolish to run on such a low ampèrage Although my system is a series system, I have provided a means of feeding in volts from separate generators, easily comparable to the feeding in of ampères in the parallel system. By this means the voltage at the generator is kept within the capacity of the dynamo just as in the other system the current is kept within limits or the drop kept within bounds. It seems to me that one procedure is quite as permissible and legitimate as the other. This feature of my system is one never before attained. This partially answers his next stricture, viz.:

"As one cannot run a dynamo over 5,000 volts with any sort of decency, it is necessary to section the line."

This is very true, but when the sections are made for this purpose they are very long—may be several miles in length, whereas in the parallel system they are usually much shorter. I see no reason why one should be fish and the other fowl. In the one case it is done to prevent drop and supply current, and in the other to prevent rise. But it is in the succeeding sentence that Dr. Hutchinson shows his entire misconception of my system. He goes on:

"The sections must be so short that it is impossible for two cars to be run on the section at the same time."

Now there are two kinds of sections; working sections and feeding sections. The latter comprise many of the former, and the case which he cites could only occur if we provided a 1 h. p. generator to run a 2 h. p. motor. On the *working* sections, two cars *cannot* run because they would be thrown in multiple with each other, and this, instead of being a disadvantage, is one of the most valuable features of my system, constituting, as it does, an absolutely perfect automatic block system.

I feel sure that it is the existent prejudice against the series system for railroads, due to numerous failures in the past, and misconceptions such as this as to what my system really is, that has caused the unfavorable criticism which it has received.

Dr. Hutchinson claims as the most fatal objection to the system that a constant current motor will not work under a load greater than the maximum for which it was built, and in praise of the constant potential motor points to the fact that it will work under considerable excess of such load. Is not this also a prejudice due to current practice? The constant current motor if overloaded will *stop*. The other, if loaded beyond a safe excess, will *burn out*. Which is the more desirable? Certainly the latter result has cost more and given more annoyance than any other dozen faults of the electric system. Dr. Hutchinson says this peculiarity of the constant current motor requires that it be built to a size to meet the maximum load. Isn't that good engineering practice? Since the constant current motor for a given horse power is considerably smaller than the other kind it can be built of sufficient power and still be small enough for street car purposes. It will not be less efficient for that reason, and when it is converted temporarily into a dynamo for electric braking purposes, which is another feature peculiar to the series system, it will certainly be an advantage in adding volts to the line. With the constant current motor we can reverse at top speed with no danger of burning out. With the other it is impossible to do this. It seems to me that if we compare the two machines the advantage certainly lies on the side of the motor required by my system.

Another objection to the series system which I anticipated in my paper, and which Dr. Hutchison raises, is that it is necessarily a double trolley system.

Dr. Hutchinson will distinctly remember the celebrated lawsuit between the Cincinnati Telephone Company and the single trolley road, which latter it was claimed destroyed or greatly injured the former's service. In this lawsuit Dr. Hutchinson was the chief expert for the single trolley road and the constant prompter of its attorney, Mr. John A. Wise. The telephone company endeavored to show that the double trolley system, which did not interfere with their service, was the peer of the single trolley. Dr. Hutchinson endeavored in every legitimate way to prove that it was not. In spite of his efforts and all the witnesses which his side could bring to testify, one of the brightest judges in the country, now on the United States Circuit bench, was not convinced. When it came to the relative cost of operating the two roads, the superintendents of both roads testified under oath as to what it cost to run his road. The result was in favor of the double trolley.

At that time there was but one single trolley and one double trolley road in Cincinnati, and none of either kind in Covington, Ky. To-day Cincinnati is networked with double trolley roads, while Covington has its system, but there is still but one single trolley road in the two cities, the original one that was there when Dr. Hutchinson was. In view of this fact, is not his assertion a little sweeping, to say the least?

As I have said, I anticipated this objection in my paper. Let me quote:

> This system will no doubt be criticised, first, on the score that it is a double trolley system which many are opposed to on general principles, and second, on the score of the high potentials necessarily involved in series distribution to long distances. Anticipating these, I will say in regard to the first that however valid the objections may be to the double trolley on multiple arc roads, they have but little force as applied to series circuits. In the latter, since both the wires on all sections not occupied by cars are of the

same potential, the difficulties of insulation of the one from the other disappear entirely. Then again, I am satisfied, from an intimate knowledge of the electric roads in Cincinnati, where with one exception they are double trolley multiple arc roads, that most of the objections raised against them are greatly magnified. They certainly have the decided advantage over the single trolley of being independent in their operation of the condition of the track, the chief objection being the difficulty of insulating the positive and negative wires from each other, which (we have seen does not hold in series roads) and the multiplication of wires, crossings and switches where many lines converge and cross. In suburban districts where these complications do not occur (and this system is particularly adapted to such) the double trolley multiple arc system is in many respects superior to the single trolley. Mr. John Kilgour, president of the Cincinnati Street Railway Company, is justly proud of the Avondale double trolley road (a suburban line), and I doubt if there is a more successful road in the country than this.

In regard to the other objection to the series method, viz., the high potentials, the method outlined in this paper permits the use of any number of feeders, each of which may be used to supply a different portion of the road, thus reducing the potential, which in series distribution is the variable quantity, in the same manner exactly that the "drop" is obviated in parallel systems.

Then, after kindly saying: "Yet certainly Mr. Perry does deserve a great deal of credit for the ingenuity with which he has worked it [the series system] out," he says: "It is well, however, to keep in mind that the *only* point at which it is even *claimed* the series system has the advantage is in the saving of copper."

If that were the only claim that the series system has for recognition I agree with Dr. Hutchison that it is but slight, but the fact is that it is the least of many claims. He has read the paper to little purpose if he failed to see the following, which, in considering the question, cannot be ignored.

After quoting Lord Kelvin, that "where power is to be transmitted to long distances," the constant current method is "*a much more economical method* than that of distribution with a constant potential, owing to the fact that to the former method thinner, and therefore less expensive, conducting wires may be employed," I say:

He might have gone much further than this. As to the cost of installation, the comparison is much in favor of the constant current method on account of the extreme simplicity of the plant required, and the smaller size of both motors and dynamos for the same output. But the economy in plant becomes most obvious where high potentials are used, and these are always necessary where long distances are concerned.

But important as are the economies in installation and in transmission of large energies to long distances, there is another that greatly outweighs them, viz., the economy in operating expenses. In this respect the series method is almost an ideal one. In the parallel or multiple arc method, when a car is going down hill or is being checked, the whole of its $\frac{m v^2}{2}$ is absolutely thrown away in the application of the mechanical brake. Not so with the series system. The mechanical brake need never be used except in the case of an emergency. By merely reversing the position of the brushes, the motor becomes, for the time being, a dynamo in series with the one at the power station, driven by gravity or the acquired momentum of the car, and the energy thus absorbed, while checking the car or bringing it to a standstill, is thrown onto the line for use elsewhere. One of the arguments used in favor of the cable road is that a car descending a grade assists another one which is ascending. If this be an argument where at least 75 per cent. of the engine power is consumed in dragging the cable alone, how much more valid should it be if the same thing could be accomplished where there was no cable to drag. Such, in fact, is the case with the series method. A descending car or one being checked assists another car that is ascending a grade or being started from rest, just as truly as it would if the two were connected by cable, and the energy thus thrown onto the line continues to contribute to the economy of the system to the last turn of the wheels. This is not mere theory. Prof. Short demonstrated its actuality on the South Broadway line in St. Louis by disconnecting the circuit entirely from the dynamo, and causing one car to partly ascend a grade on one part of the line by electrically braking a descending car on another part of the line. It has also been demonstrated in England.

The importance of utilizing electrical brake power, which is impracticable in the parallel system, is emphasized by some experiments on the Third Avenue Elevated Railroad, New York, instituted by Mr. Frank J. Sprague, to determine in what manner the power generated was utilized. The result of these was that 83 per cent. of all the power utilized was consumed in overcoming gravity and the inertia of trains, and only 17 per cent. was actually consumed in traction.

Theoretically, this ability to utilize the energy of the descending car reduces a hilly road to a level, and the ability to use the momentum of a moving car every time it is checked is to reduce a trip of many stops to one of uniform speed. In practice, theory will not be fully realized, but the saving in operating expenses must nevertheless be very large. This economy is not possible by present methods. Is it not worth looking after?

And finally, Dr. Hutchinson discusses my system on the basis that it is intended to be used on city roads. I see no very great advantage in it for such purposes. Its field is pre-eminently that of interurban or long lines. Looking at it from this standpoint, it must assume a different aspect.

In your editorial you say: "In general the series system of running electric railways appears to be old. It has been tried and consigned to the archives of the museums as impracticable." Generically it is old, nor am I advocating one of those systems that have been tried and consigned to the archives, but a new candidate for favor. It is not safe in these days to pronounce anything as "impracticable" which is based on rational principles.

I may not have succeeded in reaching the desired goal, but if not, another failure will only render the final attainment easier and nearer. The series system may be sleeping—all electricity was asleep up to twelve years ago, but he is a bold man, indeed, who says it is dead.

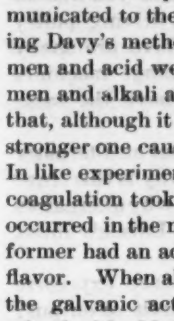
CHICAGO, Ill., Nov. 18, 1892.

A New Telephone Cable.

Messrs. Felten & Guillaume, of Mulheim-on-Rhine, have invented a new form of telephone cable, which consists of a number of quadrangular strands which are in turn composed of four conducting ribbons, of which the two exterior ones form one circuit and the two interior another. The cable is covered by canvas and lead jackets, as is usual. This forms a cable which is both solid and flexible, and the superposition of the circuits destroys the effects of self-induction.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.



BRANDE (William Thomas), F. R. S., succeeds Sir Humphry Davy as Professor of Chemistry to the Royal Institution after having long been his assistant.

He was already favorably known by many very interesting chemical experiments, one of which, treating of the effects of the galvanic current on albumen, attracted particular attention at the time it was communicated to the *Philosophical Transactions*. When applying Davy's method to fluids containing albumen, the albumen and acid were found at the positive pole and the albumen and alkali at the negative pole, and he also observed that, although it remained fluid with a weak battery, a stronger one caused it to be separated in a coagulated form. In like experiments subsequently made by Golding Bird, coagulation took place in the positive vessel, while none occurred in the negative; after a time the contents of the former had an acid taste, and of the latter a caustic alkaline flavor. When all in the positive vessel was coagulated by the galvanic action, he found there hydrochloric acid mixed with chlorine and the alkali in the negative vessel

He also repeated the experiments of Davy on the light developed by charcoal points connected with a powerful galvanic battery, and found that this light was as effectual as solar light in effecting the decomposition of muriate of silver and other bodies, and in acting upon hydrogen and chlorine gases, causing them to detonate, but he could not produce the same effect by any other terrestrial light. The moon's rays he also found to be quite inefficient upon a mixture of the two gases.

The electricity developed in flame, which had received much attention from Paul Eman and others, was likewise investigated by Prof. Brande, whose conclusions are to be found detailed at sec. iii., chap. iii., part i., of the Electricity article in the "Encylopædia Britannica," wherein the fact is recalled that A. L. Lavoisier, P. S. Laplace and Aless. Volta previously obtained clear indications of electricity by the combustion of charcoal, while H. B. de Saussure failed to develop electricity either by the combustion or explosion of gunpowder, and Humphry Davy could not obtain it through the combustion of charcoal or of iron ore in pure oxygen. In the above named article will likewise be found an account of the investigations of Pouillet and of Becquerel in the same line; some of the other well known scientists who have treated more or less directly upon the subject being E. F. Dutour, J. S. Waitz, J. F. Hemmer, Heinrich Buff, G. Gurney, Carlo Matteucci, W. R. Grove, Michael Faraday, M. A. Bancalari, W. G. Hankel, F. Zantedeschi and M. Neyreneuf.[1]

A. D. 1813.——Colonel Mark Beaufoy (already alluded to at Graham, A. D. 1722) describes in the first volume of Dr. Thomas Thomson's *Annals of Philosophy* what has by many been called the most perfect form known of the variation compass. It is also to be found illustrated at page 81, vol. xiv., of the Eighth "Britannica," wherein it is said that he employed it in the valuable series of magnetic observations made by him between the years 1813 and 1821. It consists of a telescope, underneath the axis of which is a magnetic needle whose position is alterable in order to indicate the exact angle of deviation, or the declination of the needle from the true meridian.

Brewster states[2] that when the diurnal variation of the needle was first discovered it was supposed to have only two changes in its movements during the day. About seven A. M. its north end began to deviate to the west, and about 2 P. M. it reached its maximum westerly deviation. It then returned to the eastward to its first position, and remained stationary till it again resumed its westerly course in the following morning. When magnetic observations became more accurate, it was found that the diurnal movement commences much earlier than seven A. M., but its motion is to the east. At half-past seven A. M. it reaches its greatest easterly deviation, and then begins its movement to the west till two P. M. It then returns to the eastward till the evening, when it has again a slight westerly motion; and in the course of the night, or early in the morning, it reaches the point from which it set out 24 hours before. The most accurate observations made in England were those of Colonel Beaufoy, when the variation was about 24½′ west. In these the absolute maxima were earlier than in Canton's observations, and the second maximum west about eleven P. M. Dr. Thomas Thomson alludes to the diurnal investigations of Barlow and Christie and others, and gives ("Outline of the Sciences," London, 1830, pp. 543–550) a table of the mean monthly variation of the compass from April, 1817, to March, 1819, as determined by Colonel Beaufoy. Mr. Peter Barlow, he says, has given in his "Essay on Magnetic Attractions" a very ingenious and plausible explanation of the daily variation by supposing the sun to possess a certain magnetic action on the needle.[3]

A. D. 1814.——Mr. Thomas Howldy addresses to the *Philosophical Magazine* a letter, dated Hereford, March 24, 1814, relative to "Experiments evincing the influence of atmospheric moisture on an electric column composed of 1,000 discs of zinc and silver," wherein he also makes reference to the dry pile of J. A. De Luc alluded to at A. D. 1809.[4]

The above is followed[5] by a communication on the "Franklinian Theory of the Leyden Jar, . . . with Some Remarks on Mr. Donovan's Experiments," and by a letter sent to MM. R. Taylor and R. Phillips[6] relative to the paper of Mr. W. Sturgeon "On the Inflammation of Gunpowder by Electricity" which appeared at page 10 of the last-named book.

A recent interchange of correspondence through the columns of the London *Electrical Review*, for the purpose of ascertaining the period of the earliest use of carbon as a resistant, has brought forth an extract from the "Treatise on Atmospheric Electricity," published at London and Edinburgh, 1830, by Mr. John Murray, of Glasgow, which read as follows: "Mr. Howldy, of Hereford, an ingenious electrician, had by some novel experiments clearly proved the increased power of electricity if retarded in its progress; instead of using tubes of glass filled with water, as Mr. Woodward had done, he has employed a glass tube supplied with lamp black."

A. D. 1814.——Murray (John), Scotch physician and chemist, also Ph. D., and Professor of Chemistry and Materia Medica in the Edinburgh University, is the author of works "On Electrical Phenomena," and on the new substance called Jod (Iode), as well as "On the Phenomena of Electricity," published at London, respectively, during the years 1814 and 1815.[7]

Dr. Murray died July 22, 1820, in Edinburgh, the place of his birth, as will be seen by reference to Larousse, "Dict. Univ.," vol. xi., p. 706, and to Poggendorff, vol. ii., pp. 243, 244. He should not be confounded, as has been done by many, with *Mr.* John Murray, whose papers, read before the Royal Society,[8] treat of the relations of caloric to magnetism, of the unequal distribution of caloric in voltaic action, etc., of the ignition of wires by the galvanic battery, of lightning rods, conductors, etc., etc.[9]

Mr. John Murray is said to have been a lecturer on experimental philosophy and one of his most interesting reviews is the one appearing at page 62, vol. xliii., of the *Phil. Mag.* regarding Ezekiel Walker's theory of combustion as deduced from galvanic phenomena. At page 17 of this same volume is a paper from Mr. John Webster on the agency of electricity in contributing the peculiar properties of bodies and producing combustion, while, at page 20, is a letter from Mr. George J. Singer wherein he calls Mr. Walker a novice in the science of electricity who, among other things, "has yet to learn that a conducting body supported by dry glass and surrounded by dry air may be still very far from being insulated."

The treatise of Mr. John Murray on "Atmospheric Electricity" previously alluded to (at Thomas Howldy, A. D. 1814) was translated into French (Mém. de l'Elec. Atm.") by Mr. A. Riffault, Paris, 1831.[10]

[1] See *Phil. Mag.*, vol. xliv., p. 124; *Phil. Mag. or Annales*, vol. ix., p. 246; *Annales de Chimie*, 5e série vol. ii.; *Phil. Trans.* for 1819 and 1820; *Mémoires de Mathématiques*, vol ii., p. 246.

[2] Eighth "Brit.," vol., xiv., p. 54.

[3] See *Phil. Mag.*, vol. liii., 1819, p. 387; lv., 1820, p. 394; W. S. Harris, "Rud. Mag.," parts i., ii., pp. 150–152; "Encycl. Metrop.," vol. iii. (Magnetism), pp. 766, 767; *Annals of Phil.*, series i., vols. ii., vi., ix., xvi., and N. S. vol. i., p. 94, for Beaufoy's own summary of all his observations.

[4] See *Phil. Mag.*, vol. xliii., pp. 241, 323, and *Nicholson's Journal* vol. xxxv., p. 84; also the *Phil. Mag.*, vol. xli., p. 393, for a description of the electric column of 20,000 pairs of zinc and silver plates, and others, constructed during the previous year (1813) by Mr. George J. Singer.

[5] *Phil. Mag.*, vols. xlvi., pp. 401-408, and xlvii., p. 285.

[6] *Phil. Mag. or Annals*, vol. i., p. 343.

[7] Referred to in Tilloch's *Phil. Mag.*, vols. xliii., pp. 270-272; xlv., pp 38-41. See "Catalogue Sci. Pap, Roy. Soc.," vol. iv., pp. 556, 557.

[8] "Catalogue Scientific Papers," vol. iv., pp. 557-559.

[9] These papers appear in Tilloch's *Phil. Mag.*, vols. liv., 1819, pp. 39-43; lviii., 1821, pp. 380-382; lx., 1822, pp. 358-361; lxi., 1823, p. 207; lxii., 1823, p. 74; lxiii., 1824, pp. 130, 131; L. F. von Froriep, "Notizen. . ." for 1823, vol. iv., col. 198; *Edin. Phil. Jour.*, vols. xiv. for 1826, pp. 57–62; xviii., for 1828, pp. 88–91; and in Sturgeon's *Annals*, vols. iii., for 1838-1839, pp. 64–68; vii., for 1841, pp. 82-83.

[10] Consult *Phil. Mag.*, vols. xliii., p. 175; l., pp. 145, 312; lii., p. 60; liii., pp., 268, 468; lviii., p. 387; lx., p. 61; lxi., p. 394; lxii., p. 456; lxiii., p. 130; also pp. 306, 307 of Fahie's "History," regarding John Murray's "Notes to Assist the Memory in Various Sciences."

Moonlight Tables for December, 1892.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of December, under his modified form of moon schedule:

TABLE NO. 1. Standard Moonlight, Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	2:55 A. M.	1	6:05 A. M.	1	5:10 P. M.	1	12:00 M.
2	No light.	2	No light.	2	5:10	2	12:00
3	No light.	3	No light.	3	5:10	3	12:00
4	No light.	4	No light.	4	5:10	4	12:00
5	5:05 P. M.	5	7:00 P. M.	5	5:05	5	12:00
6	5:05	6	8:10	6	5:05	6	12:00
7	5:05	7	9:25	7	5:05	7	12:00
8	5:05	8	10:35	8	5:05	8	12:00
9	5:05	9	11:40	9	5:05	9	12:00
10	5:05	11	12:45 A. M.	10	5:05	11	12:45 A.M.
11	5:05	12	1:45	11	5:05	12	1:45
12	5:05	13	2:50	12	5:05	13	2:50
13	5:05	14	3:45	13	5:05	14	3:45
14	5:05	15	4:45	14	5:05	15	4:45
15	5:05	16	5:45	15	5:05	16	5:45
16	5:05	17	6:20	16	5:05	17	6:20
17	5:05	18	6:20	17	5:05	18	6:20
18	5:05	19	6:20	18	5:05	19	6:20
19	5:05	20	6:20	19	5:05	20	6:20
20	5:10	21	6:20	20	5:10	21	6:20
21	5:10	22	6:20	21	5:10	22	6:20
22	5:10	23	6:20	22	5:10	23	6:20
23	5:10	24	6:20	23	5:10	24	6:20
24	9:05	25	6:20	24	5:10	25	6:20
25	10:15	26	6:20	25	5:10	26	6:20
26	11:25	27	6:20	26	5:10	27	6:20
27				27	5:10	27	12:00 M.
28	12:35 A. M.	28	6:20	28	12:35 A. M.	28	6:20 A.M.
29	1:50	29	6:20	28	5:10 P. M.	28	12:00 M.
30	3:05	30	6:25	29	5:10	29	12:00
31	4:25	31	6:25	30	5:10	30	12:00
				31	5:10	31	12:00
Total hours lighting, 281.10.				Total hours lighting, 310.15.			

Oil Versus Air as an Insulating Medium.—II.*

BY JAMES BOWSTEAD WILLIAMS, M. D.

The oils tested were rosin, paraffine, linseed, cotton-seed and castor. The rosin oil was what is known as London oil. The paraffine oil had a specific gravity of 24 degrees B. All of the samples were procured from wholesale dealers, and were declared to be of the best quality.

The first set of experiments include tests of paraffine and rosin oils, air and a specimen of a well-known insulated wire. This last test was made to show what took place when the dielectric of insulated wires was tested by means of charges of high potential, and also to make a rough comparison between the specific resistance of this dielectric and that of the oils about to be tested.

The temperature during the tests was 82 degrees F., and the humidity, as indicated by a Lambrecht polymeter, 86.

It was first ascertained by testing that the quadrants used and the discs were absolutely insulated. Each separate experiment is designated by a number.

1. Paraffine oil was then poured into the cup and the discs separated one-ninth of an inch. The discharge key was not used in these tests in order to save time, a wire fastened to the gas pipe being used to ground the lower disc. The connections were properly made and the quadrants fully charged. As soon as the image of the cross wire had become stationary, the electrode of the lower disc was touched with the ground wire. The image immediately flew down the scale, apparently as fast as if the upper disc had been touched with the ground wire. That this sudden flight of the image was not due to the "drop," *i. e.*, to absorption of the charge or the sudden rush of the electricity into the oil and not through it, was proved by repeatedly charging the quadrants, and then discharging them through the oil. In fact, the amount of leakage was so great that, while the lower disc was kept grounded, the quadrants could not be charged.

If leakage through a very thin layer of any good dielectric be not too excessive, the quadrants can always be recharged, wholly or in part, even while the leakage is going on; but, in this case, the leakage was too great, even when sparks were rapidly poured into the quadrants.

2. The discs were next separated one-fourth of an inch, but no better results were obtained than at first.

It is evident that there must have been less leakage through a layer one-fourth of an inch thick than through one one ninth of an inch thick. But, in both cases, the movements of the image were too rapid to be timed.

3. The cup was then emptied of the oil and a few drops introduced between the discs, and still no different results were obtained.

4. The oil was then heated to about 280 degrees F., to expel any moisture that might be present. But this made no difference in the tests; there was still great leakage, even after the oil had cooled.

5. Rosin oil was then subjected to the same tests as the paraffine oil, but no better results were obtained from it than from the paraffine oil.

6. All oil was removed from the discs and a layer of air one eighteenth of an inch thick tested. The drop was about five divisions, but after that the image remained stationary, thus showing that the insulation resistance of the air, at the potential used, was absolute.

7. A piece of the insulated wire above referred to, about five inches long, was connected with the quadrants and the quadrants charged. The edge of a pocketknife blade was then held transversely upon the dielectric, when the image passed rapidly down the scale. This experiment was repeated and the same result obtained. The ends were then paraffined and the specimen again tested. Result almost the same as before paraffining, thus showing that there had been some surface leakage at first.

Many of the insulated wires now in use yield the same results when tested exactly as this present sample was tested. But there are also many which give excellent results when thus tested, and there are a few in which there is very little leakage even when several feet are formed into a condenser and tested at this same potential.

It is important to remark that tests of different sections of the same wire, having a vulcanized dielectric, may not always give the same results. For example, a three-inch piece of a certain wire may have a very high internal resistance, while the next three inches may have an internal resistance much lower than that of the first. Where this is the case, it will almost always be found that the dielectric of the second sample contains some flaw, or else has particles of wood, metal, etc., embedded in the mass.

By using this method of testing, the superiority of one insulated wire over another, whenever samples a few inches long can be obtained, can easily be demonstrated. It will readily be seen that this fact may become of great importance in legal or other cases in which the comparative insulation resistance of wires is involved. Decisive results can be obtained in many cases from lengths of two or three inches only.

The second set of experiments included tests of all five oils, paraffine, wax, ordinary air and steam. The temperature was 80 degrees F., and the humidity 75.

In the second set, the layers of oil were formed between an upper disc nine-sixteenths of an inch in diameter, and a lower disc 1¼ inches in diameter. This lower disc was the flat bottom of a tin box. It sides were covered with a thick layer of paraffine wax, so that no leakage could take place except through the layers of oil. The discs were mounted the same as the larger discs, and were absolutely insulated from each other and from earth.

1. Paraffine oil was first tested in a layer one-quarter of an inch thick, but the falling of the image was too rapid to be accurately noted. A layer one-half inch thick was then tested, and gave a fall of 207 divisions in one minute.

2. Rosin oil tested in a layer one-quarter of an inch thick gave a little better results than the paraffine oil; but when a layer one-half inch thick was tested, the fall was 177 divisions in one minute.

In these two tests of the two oils all effects due to the drop were eliminated by repeated chargings, so that the fall due to leakage alone was noted.

3. Linseed, cotton seed and castor oils were each tested in one-half inch layers, but as the fall of potential was so much greater than that of the other two oils no further tests were made of them.

Of the three, castor oil had the lowest specific resistance; and there was but little difference between the linseed and the cotton seed oils, what little difference there was being in favor of the linseed oil.

4. A layer of paraffine one-sixteenth of an inch thick and free from air bubbles was next formed between two tin discs, each 1⅝ inches in diameter, and tested like the layers of oils. When the ground circuit was closed the drop was just five divisions. The quadrants were again fully charged, and the falling of the image noted. This fall was one division in two minutes, or 30 divisions in one hour.

5. A brass tube 10 inches long and five-sixteenths of an inch in diameter was next used for a receptacle for oil. In the centre of this tube was a straight copper wire one-sixteenth of an inch in diameter, the wire being kept concentric with the tube by means of two hard rubber plugs with holes through their centres. The tube contained rosin oil. The wire was connected with the quadrants, and the tube absolutely insulated from the earth and neighboring objects.

The quadrants were then charged and the tube grounded. The image passed down the scale too rapidly to have its rate of falling timed. The hard rubber plugs were carefully paraffined so that all of the leakage took place inside the tube.

A torrent of sparks was poured into the electrometer, but it could not be charged on account of the rapid leakage through the oil.

6. Three plates of glass each 3 by 4 inches and one-eighth of an inch thick were carefully cleaned and then dried over a lamp. Before they had cooled, one was covered with a film of rosin oil, one with a film of paraffine oil, each film having an area of about two square inches, and the third had a film of paraffine wax about one inch square formed on it. A No. 20 copper wire was fastened to the quadrant electrode, and its free end placed in contact with the centre of the film on the glass. The glass was insulated and the quadrants charged. The image remained stationary as long as the glass was insulated, but as soon as any conducting body, the hand for instance, came in contact with any portion of the glass plate, leakage over the film of material on the glass occurred. In each case there was a slight drop, but the quadrants were immediately recharged. The rate of falling of the image with the glass plates covered with the oils was practically the same, the fall being about 5 divisions to the second; but with the paraffine wax the image remained stationary.

Repeated chargings failed to alter the rates of falling of the image.

7. The last tests were made with air and steam, and in both tests the layers were formed with the device used to ascertain the potential of the fully charged quadrants. In the first of these tests the discs were separated a trifle more than .03 of an inch.

The drop in this test was just two divisions, but after that the image did not move in 20 minutes. The writer has made this same kind of test in former years, and has allowed the instruments to stand for hours, and yet there would be no leakage through the layer of air.

(To be continued.)

*A paper read at the General Meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 8.

The Cost of Electric Supply.—I.*

BY DR. JOHN HOPKINSON, F. R. S.

The interests of an engineer are many sided. If he is to successfully use the forces of nature for the service of man he must understand how those forces work; he must, in fact, be scientific. It may be that his ideas are arranged differently from the ideas of those who study science for its own sake, and without regard to practical applications, but if he is to succeed they must be so arranged that he can deduce from knowledge already acquired knowledge which is applicable to new cases which have not as yet come under his observation. The engineer who can only do that which he has seen done before may be a practical man, but he will always belong to a lower grade of his profession. The scientific engineer is one who by his knowledge of nature is able to deal with new engineering problems and provide useful solutions of those problems. But a practical man must be something more than a man of science, or rather he must look at matters from a different point of view. He cannot choose some feature of a problem, concentrate all his attention upon that, and leave other matters out of consideration, which is the process by which most scientific advance has been made; but he must always deal with the whole matter before him and leave no relevant question out. But an engineer may be scientific inasmuch as he has knowledge of nature and the power of applying that knowledge in new cases; he may be practical in the sense that the means he devises to attain his ends may be complete at all points, and not break down from trifling defects, and yet may find that there are other subjects which he has to consider. Our complete engineer must give his attention to commercial matters as well; he must know if, when he has devised the means to attain the ends in view, those ends when attained will result in a profit. He must recognize the conditions which render an undertaking economical to work, and which secure that it shall bring in a large return. When it has been my lot to address engineers, I have usually directed attention to some scientific point which I thought would be of interest to them. This evening I should like to go to the other extreme and deal with a purely commercial question, with a matter into which no science enters, and which relates entirely to pounds, shillings and pence.

You are all of you familiar with the fact that the expenses of an undertaking may be broadly divided into two classes: On the one hand there are expenses which are quite independent of the extent to which the undertaking is used, and on the other, expenses which are absent unless the undertaking is used, and which increase in proportion to the use. For example, the charges for interest on the construction of a bridge are the same, whether that bridge is used much or little or not at all, and the cost of maintaining the bridge is also practically independent of its use. The same is true in a large measure of a harbor or a dock. Such undertakings lie at one extreme of the scale. It is less easy to find good examples at the present day of the other extreme, as nearly all undertakings with which engineers have to deal require the employment of some capital, and there will be a fixed charge for the use of that capital and for maintaining against the assaults of time the things in which the capital is embodied. But we can readily see for example in the case of a cotton mill that, if on the one hand there are expenses for interest and dilapidation which are independent of the amount of yarn actually manufactured in a given factory, there are other expenses for material and labor, and even for actual wear of machinery which will be very nearly proportional to the output. Undertakings vary enormously in the proportion of these two classes of expenses, in some the expense is quite independent of the extent of the use, in others it is for the greater part proportional to the use.

But undertakings differ from each other in another respect. In some cases the service which the undertaking is designed to render can be performed at a time selected by the undertaker; in others at a time selected by him to whom the service is rendered. In the case of most manufacturers it matters not if the thing made is made to-day or to-morrow, in the morning or the evening, for it will not be used for a month hence, perhaps; the thing can in fact be extensively stored and kept till it is wanted. Other services must be rendered at the moment the person served desires. For example, the Metropolitan District Railway must be prepared to bring in its thousands of passengers to the city at the beginning of the day and to take them back in the evening, and for the rest of the day it must be content to be comparatively idle. In this case the services cannot be stored. The line must be of a carrying capacity equal to the greatest demand, and if this be great for a very short time the total return for the day must be small in comparison with the expense of rendering the service. In such a case it would not be inappropriate to charge more for carrying a person in the busy time than in the slack time, for it really costs more to carry him.

Let us see how these considerations apply to the supply of electricity for lighting. Electrical engineers now realize that they have to provide the same plant and no more to give a steady supply day and night as to give a supply for one hour out of 24. They also now realize that if they are to be ready to give a supply at any moment, they must burn much coal and pay much wages for however short a time the supply is actually taken. Indeed, the term "load factor," proposed by Mr. Crompton, is as constantly in the mouths of those who are interested in the supply of electricity as volt or ampère or horse power. The importance of the time during which a supply of electricity is used was so strongly impressed on my mind years ago that in 1883 I had introduced into the Provisional Orders, with which I had to do, a special method of charge intended to secure some approach to proportionality of charge to cost of supply. Unfortunately the orders of that day all came to naught.

A supply of electricity must be delivered at the very moment when the consumer choses to use it, and as long as and no longer than he pleases to use it; it cannot be very readily or cheaply stored, and much of the cost of production is the fixed charge for plant and conductors. Furthermore, the Provisional Orders require that the supply shall be available at all hours; hence coal must be consumed, and workmen must attend, though but few consumers are drawing a supply. The service of supplying electricity has, from an economic point of view, a great deal of similarity to the service of providing a breakwater for a harbor. A

* Presidential address delivered before the Junior Engineering Society, London.

great deal of the expense is independent of the number of hours in the day during which the supply is used. To put it in another way, the cost of supplying electricity for 1,000 lamps for ten hours is very much less than ten times the cost of supplying the same 1,000 lamps for one hour, particularly if it is incumbent on the undertaker to be ready with a supply at any moment that it is required.

(To be continued.)

Alternating Current Laboratory Work at Cornell.

With the opening of the present year at Cornell University the department of electrical engineering added a line of study, including both lectures and laboratory work, dealing with the alternating current, that, so far as we are aware, has been established as a separate department at no other educational institution in this country. Prof. Nichols has selected Mr. Frederick Bedell, a graduate of Cornell, to take charge of the work. Besides lectures, experimental work of various kinds has already been carried out with great success, especially in the measurement of power and the investigation of the heating effects of alternating currents as distinguished from the same effects produced under similar circumstances by direct current. The difference in the two has been carefully measured by distinct methods and with very satisfactory results. Before the close of the year it is expected that some work in efficiency measurements of alternating current motors, and some multiphase experimental investigation, will be inaugurated.

The Use of Compound Wound Generators from a Practical Point of View.*

BY W. M WILLIS.

I have been asked to read a paper this evening on a subject which would bring up a good warm discussion, and I believe, if I am not much mistaken, I shall, before I am through, have struck the right chord to realize the desired result. The subject I have selected is the compound winding of generators from a practical standpoint, with especial reference to their use in practice.

In the first place we find that in all electric installations, whether for incandescent lighting or power transmission, the first requirement is that the dynamo or dynamos shall maintain a constant potential difference at the brushes or at some distant point. On examination we find that the shunt machine by armature reaction alone as a single factor, not to mention the host of other factors which enter into the equation, is unable, in practice or theory, to fill the before mentioned requirement, viz., to keep a constant potential difference at any point predetermined, without hand regulation or some form of governing device, such as an automatic rheostat, for instance. Therefore, one has to look for some one of the many devices introduced which will the most nearly fill the requirements in practice as well as in theory; and I believe it has been decided by electricians the world over that the requirements are the most nearly reached by the compounded machine, the electromotive force of which keeps constant or increases directly as the load on the machine increases.

We find in the building of compounded machines that certain conditions are assumed. In the first place we find that the speed of the machine is assumed constant, whatever that constant may be. This, of course, introduces a slight source of error, as in practice, in a large percentage of cases, more especially small plants, the speed varies at least two per cent., as I believe two per cent. variation in speed between full and no load is about the best warranty obtainable on the greater number of makes of high speed engines with which one in modern practice has mostly to deal, and this, be it remembered, does not take into consideration the creepage of dynamo belts, which amounts to from one and one-half to two and one-half per cent. by actual experiment, not to mention belt slippage. All these factors, of course, increase in direct proportion to the load. In railway practice and in the transmission of power a few per cent. variation is, however, permissible.

It would seem advisable to over compound even railway generators to a slight extent to make up for small variations of speed. This may be accomplished in some machines without special winding, as, for instance, by varying the length of a German silver shunt used to shunt a portion of the main current past the series coils and thus allow a larger proportion of main current to flow through the series coils of the machine. In incandescent lighting, however, variations of speed are attended with far more evil results, and in only too many cases the dynamos are blamed for inconstancy of the candle power of lamps when it is the transmission of mechanical power to the dynamo shaft that is at fault.

We will now consider the use of the compounded and over-compounded machines under various conditions. We will first take the case of a compound wound machine running singly, and we find that its series winding may be constructed with such a number of turns that it will practically compensate automatically from no load to full load; for all internal reactions, such a machine is evidently eminently fitted for railway and similar work, as it will maintain a practically constant potential at the generating station.

*A paper read before the Chicago Electric Club.

The next case will be one in which we have an over-compounded generator, running singly, and we find that its series coils if correctly constructed will fairly compensate for internal reactions, and also for the varying percentage of loss in line, all of which vary directly with the current. A machine of this class and under these circumstances would be admirably fitted for incandescent lighting and transmission of power, and more highly fitted for railroad work than a straight compound machine.

The next case we will take up will be one in which we have two compound wound machines running on the three wire system. Their series windings will compensate for internal reactions and thus keep the potential at generating station constant, even if the system becomes unbalanced, as the excess load on one side above the other would pass through the series coils of the more heavily loaded machine and increase its magnetic field, thus keeping its potential at a level with the more lightly loaded machine. Under similar conditions, of course, a shunt machine would lower its potential.

The next case we will take up will be one in which we have two over-compounded machines running on the three wire system, and one finds that however unbalanced the load may be, both machines will maintain a practically constant potential at any predetermined point if the compounding is correctly figured. One hundred and ten volt dynamos of such a type and under such circumstances would be the correct thing for incandescent lighting where the distance of lamps from the generating station does not exceed one-half mile, and where the cost of conductors on the 110-volt system and the cost of transformers on the alternating system would make these systems too expensive in comparison with the 220-volt system. A system of this kind would also be fitted for the distribution of power over short distances of say one-half mile on the 220-volt and three miles on the 1,000-volt system.

The next case we will take up will be one in which we have compound wound generators running in multiple on the two-wire multiple arc system. We find that the generators will compensate for internal reactions, but will not compensate for loss in transmission. Machines of this form and running in multiple would be but little better than straight shunt machines, one of the only advantages being that they would divide the total load among them more equally than shunt machines would under similar conditions.

The last case we shall take up will be one in which we have over-compounded generators running in multiple. The series winding will fairly compensate in the average manufacturer's machine for internal reactions due to varying load and also when all machines are running for all variations in loss in the system due to varying load. It is this form and arrangement of generators for incandescent lighting which is at present rightly popular for isolated plants.

We will now turn to a case in which this arrangement of over-compounded machines in multiple will not maintain a constant potential at the lamps. The case we will take will be one in which we have two or more compound machines running in multiple, and suppose we are running our feeders at 10 per cent. loss and at some time we have but one-third of our total load of lamps on. Now it is poor economy to run two or more dynamos on a light load when one can take the total load. Therefore, in practice we would cut out all the generators except one, and in doing this we should find that the voltage at the lamps would increase considerably, for the reason that when at full load, with all machines running, our loss is 10 per cent. in feeders and the voltage of lamps correct. When we cut two-thirds of the lamps off our loss drops in direct proportion and we have each machine taking its equal share of the reduced load, which share passes through its series coils producing the correct voltage necessary to run the lamps at the new percentage of loss in feeders. When we cut out all machines but one, say, then the total current which was previously divided among all machines will be drawn from the remaining one, and in consequence will pass through its series coils, and thus raise the voltage at the lamps, because the percentage of loss in feeders has varied from 10 per cent. to the percentage of loss at one-third load.

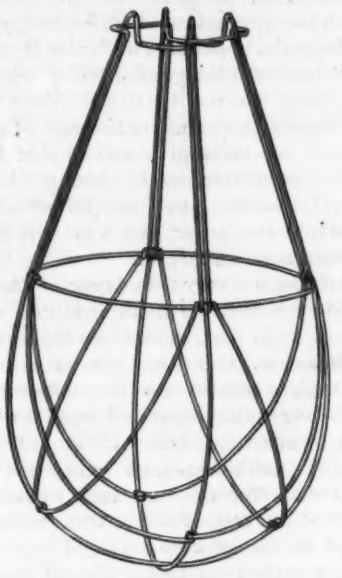
This case may prove very serious with 110-volt lamps. On two-wire multiple arc systems, for instance, the voltage at lamps would vary from 110 volts to at least 118 volts. Of course in this case hand regulation with ordinary generators would have to be resorted to, and the only benefit derived from the compound winding would be the accurate division of load between compound wound generators running in multiple and the practically automatic regulation obtained for varying loads with all machines running.

A solution of this problem of how to keep voltage at lamps down when all machines but one are cut out would be to either wind the series coils in sections and when machines are thrown out to short circuit a certain portion of each of the series coils of the balance of the generators or to operate a shunt of variable resistance, which shunt would cut down the current flowing through the series coils in direct proportion to the number of machines cut out. In addition to this it would also be advisable to excite the shunt field spools of all machines from a separate exciter, run from an independent source of power from that which runs the generators themselves.

One finds in practice that few compound machines will maintain within one per cent. constant potential at any predetermined point, as a factor will creep in which it is almost impossible to provide for in the compound winding, and that is the heating up of the machine, which depends on the ventilation of the machine itself, on the ventilation of the dynamo room, and also on the temperature of the outside air. Therefore, in conclusion, it should be said that in general too much is expected of a compound or over-compound machine and too few allowances made.

The Acme Expanding Wire Guard.

The Acme expanding wire guard is the latest device for the protection of incandescent lamps. It differs from any of the others on the market in the fact that it requires no auxiliary clips or catches, but secures itself firmly on the socket in a way that is almost automatic. It has a very firm hold on the socket, having a bearing contact longitudinally on the shell of over half an inch, making it impossible to force it against the lamp with a blow. The guard itself is also made particularly strong and rigid. In appearance it is very neat and symmetrical, as the accompanying illustration shows. The Acme guard is being placed on the market by the Electric Appliance Company, of Chicago, which is the manufacturer and sole agent.

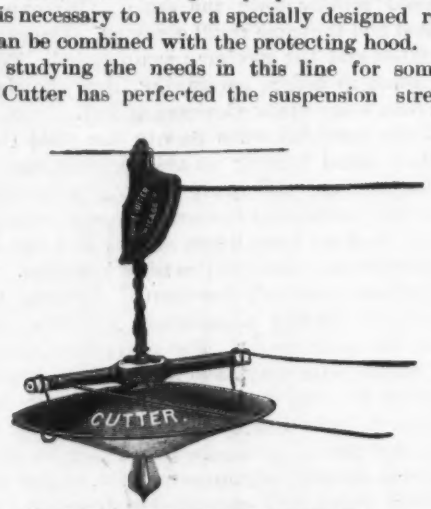


The Acme Expanding Wire Guard.

Cutter's Suspension Street Hood.

Street lighting with incandescent lamps is becoming quite a common practice in all parts of the country, and in many places the lamps are hung over the centre of the street. This plan is the best on shady streets where the foliage would cut off much of the light from a lamp placed at the corner. Then, in order to get a proper distribution of the light, it is necessary to have a specially designed reflector, which can be combined with the protecting hood.

After studying the needs in this line for some years George Cutter has perfected the suspension street hood shown in the accompanying cut, which embodies a number of novel features. The hood is designed so as to thoroughly protect the socket from the weather, while a unique spring catch and hinge allows it to be opened when desired. The nozzle which supports the socket is arched so that it can be readily wired, and the tin parts are separable so that they can be nested for shipment. Another patented feature is the method of clamping the parts of the crossarm, whereby the hood itself is insulated from the suspending cable. The pulley used with this hood is known as "Cutter's Petite" and is a small size of the lamp-supporting pulley designed for arc lamp practice, holding the hood safely even if the hoisting rope should slip.



Cutter's Suspension Street Hood.

The same suspension outfit is also used by some plants on alternating circuits with the transformer hung just above the hood, and in all cases makes a neat and very serviceable combination. George Cutter, of Chicago, is the patentee and sole maker.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Nov. 26, 1892.

New York General Financial Stock Market.—The world of Wall Street spent the early part of the week in speculating upon the probabilities of gold exports, a d later, when it was definitely learned that $600,000 was to go, in guessing how much more would follow next week. Exports of gold at this season of the year are most unusual, and indicate a condition of financial affairs not at all favorable to this country. The balance of trade is largely in our favor, and there are plenty of cotton and grain bills in our banks and clearing houses. For three weeks sterling exchange has been creeping dangerously near the exporting point. The present rate of 4.88¼ is regarded as hardly sufficiently high to afford a margin of profit, and unless it goes higher there will be no pronounced move ment. The causes for this high exchange, when by all laws of trade it should be at about $4 82 or $4.83, are very indefinite, but in a general way are conceded to be a European distrust of our currency system because of the operative Sherman silver law. There also prevails the belief that European governments are hoarding gold. The United States has always been found the most liberal in her gold movements and in consequence the slightest demand for the precious metal is almost invariably felt in this country. There is plenty of money abroad and an equal abundance here, while our cotton and grain still unsold will give us still larger credits in Europe. Students of the situation do not anticipate a very large export. The advance in cotton is most important in its bearing upon the industrial prosperity of the country. It is caused by a shortage of 2,000,000 and, perhaps, 2,500,000 bales as compared with last year. Assuming the 1891 crop was sold with little or no profit, the advance in price this year over last will give to the South a profit of over forty-two million dollars. Owing to the agricultural nature of her industries this section is almost wholly dependent upon manufacturing centres for supplies. Already the effect has been felt, and orders for much needed goods are coming in. The feeling that prosperity is in store for this section is reflected in the various state and municipal bonds, all of which show upward tendencies. The importance of this prosperity on the electrical industry can hardly be over estimated. For two years a large number of street railway and lighting enterprises have been hanging fire through lack of resources and an inability to float bonds. The South is sorely in need of these improvements and is expected to respond promptly. The state of trade throughout the community is excellent. Commercial centres report plenty of money and easy rates. The grain movement continues heavy, railroad earnings show increases and the coal trade is improving under restriction. The bank statement shows a substantial increase in lawful money. In the stock market the bear influence dominated. Gold exports and their dire consequences were magnified to a degree that precipitated a general decline. The industrials were the leaders as they were in the advance, and through a lack of supporting orders scored the greatest declines. The market closed badly shattered on the report of Mr. Jay Gould's death, and its opening is uncertain. Gould's death is a trump card with the bears which never fails to score when played. Incidentally it might be remarked that Mr. Gould is in the enjoyment of usual health.

NEW YORK FINANCIAL STOCK MARKET.

In General.—It has been the most quiet week in electrical securities experienced in months. There was nothing doing except in a few specialties, and these did not attain more than a semblance of the usual volume of business. The best, excepting Western Union and General Electric, were influenced almost entirely by the bearish tendencies of the general market. There were no raids on the stock and no particular attention devoted to them. Values as a rule fell off, while there was an almost total lack of transactions in bonds. The market next week will follow closely that of the industrials and if indications are indicative will be heavy at least during the first two or three days, or until the question of gold imports resumes definite shape. Of minor mention we find strong bids for Commercial Cable with no transactions, showing that the stock is in strong hands.

Westinghouse.—Fifty shares of the E. & M. assenting certificates sold at 73¾. Nothing new is heard concerning this company's new incandescent lamp, although one is confidently expected by the trade as per promises. The defeat last week of the company in seeking to keep the Edison company from obtaining a temporary injunction prohibiting the use of the incandescent lamp shut off for the time being, at least, the u e of the lamp. The grounds of defence, viz., that the General Electric is an illegal trust, were held not to be valid. This plea will also be apt to stimulate General Electric to demand its pound of flesh, and is liable to engender some hard feeling. The case goes to the United States Court of Appeals Dec. 6.

General Electric.—The course of this stock was downward. Sales were comparatively very light and there was manifest no disposition to hold up prices. The alleged cause of the decline was set forth in THE ELECTRICAL WORLD last week, namely, the possibility that the company will back the Wellington Adams electric railway project. Whether Wall Street regards the plan as feasible or not the enterprise is going ahead, and is said to have strong backing. Ten miles of the line are already graded. The stocks and bonds are on the market, $7,000,000 of the former and $6,000,000 of the latter. The General Electric stock sold down as low as 110. The decline in the debenture 5 per cent bonds started last week because of the proposed issue of $6,000,000 additional palled, and a recovery of a fractional point made. Sales of $22,000 were made at 103¼ to 103½.

North American.—From an opening of 13½ the stock sold down to a closing of 12⅝ to 12¼ on limited transactions. Vice-President Jones says that the affairs of the company are prosperous. Preparations for the motor test on the Chicago and Northern Pacific belt line are still going on. One locomotive is now being built for this purpose.

American District Telegraph.—The stock was almost wholly neglected. The only item of interest which developed during the week was the notice issued to users of the service that hereafter a rental of 50 cents per month will be charged in addition to regular charges, for use of the call boxes. When the Mutual District Telegraph Co. was a competitor there was a continual strife between the two companies to put in their call boxes free of charge. But now that the consolidation has taken place it is different, and the public?—well, it "must grin and bear it."

Edison Electric Illuminating.—This is the only stock on the list which showed any strength. The quotation of 110, the lowest in its history, was reached. The decided weakness of the general market on Saturday caused a decline in sympathy, and the closing was 108¾. The tendency is upward, and we would not be surprised to see it sell higher within a short time.

Western Union.—It will be remembered that last week we prophesied that the course of this stock would be one of decline, giving our reasons and presenting figures. It was at about par the day before the dividend was due. Ex dividend it sold on the same basis at 90. We set forth the fact that it had reached this first figure in discount of the dividend, and now that there is $13,80 ,000 more stock on which to pay six per cent. it was not worth $90. The lowest point reached was 86¾. If it reaches a quotation on its merits it will go to 80 or thereabouts.

Copper Market.—As we prophesied, the closing of navigation has added a half a cent per pound to the price of lake copper. Heavy sales were made during the week at 12 cents. The Calumet & Hecla leads the market. Most of the 10,000,000 pounds contracted is attributed to this company. It is said to be holding for 12½ cents. As was to be expected, the volume of exports fell off because of the advanced price, amounting to about $23,000 in matte and $21,000 in fine copper. The market closed firm, with a good future before it. Consumers are quite generally providing stocks on the advance. Lake copper can still be bought for 12 cents in small quantities.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Nov. 26, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	....	....	57	59
American Tel. & Cable..	100	14,000,000	86	86	84½	86
Central & So. Am. Tel....	100	6,000,000	....	....	....	....
Commercial Cables.....	100	7,716,000	....	....	168	175
Gold Stock & Tel	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	*86¾	90½	86¾	87¾
Real estate bonds.....	1,000	1,219,000	....	....	....	
Debenture bonds.....	1,000	4,920,000	....	....	....	..
Collateral Trust 5's....	1,000	8,181,000	....	....	....	
North American.....	100	39,767,200	13½	13⅝	13⅝	12⅞
Brush Ill. Co. of N.	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	108¾	110	108¼	108¾
" " Ists.....	...	.....	....	....	....	..
" " Deb's.....	...	.....	....	....	....	....
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....	....	65
General Electric.....	1,000	50,000,000	110¼	113½	110	110½
Debenture 5's		.....	103¼	103½	....	....
Automatic Exhibition Co. ...		2,500,000	...	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E & M. Co. 1st p. 7 per cent., Cum.	50	3,717,253	....	....	....	....
E. & M. Co. Assg.....	50	5,038,116	73¾	73¾	....	....

WALL STREET NOTES.

"Where Are We At?" is the question quite frequently asked these days among the papers holding Associated Press franchises. It now appears that the breach between the Western and Eastern associations is widening, and that by the last of this month will be unbridgeable. Already the Eastern body has stationed correspondents in important Western news centres.

A Reported Lease.—It is reported that the Postal Telegraph Company has leased the Commercial Telegraph Company its connection in Eastern New York, New England and its Canadian connection.

Time Extended.—The American Bell Telephone Company and Prof. Bell asked Judge Nelson in United States District Court for time until Nov. 4, 1893, to introduce further testimony before examiners in the suit of the United States to annul the Bell patent of 17 years ago on the ground that Daniel Drawbaugh was the inventor. The Court granted four months.

It is said that all save a very few shares of Edison General and Thomson-Houston have been deposited under the consolidated circular.

Extensive Bookkeeping.—It is estimated that the General Electric Company must have 5,000 accounts. The Thomson-Houston Company had 3,000 at the time of the consolidation.

A Big Showing.—The Erie Telegraph and Telephone Company has paid 36 dividends since June, 1883, aggregating (including that paid the American Bell Telephone Company) a sum exceeding $1,650, 00, and the entire plant is in a condition to-day equal to any telephone property in the country. The subscribers since 1885 have increased 5,304. The gross earnings are now at the rate of $900,000 per annum, an increase of $375,000 over 1885, and there is a corresponding net increase of $125,000 per annum. There are 14,727 subscribers connected and increasing 1,200 annually. Treasurer Glidden attributes the advance in the stock to the fact that the public is beginning to realize the value and condition of the company's property. He says the growth the past five years has been marvelous and the company is increasing in subscribers to-day at a greater rate than ever before.

BOSTON, Mass., Nov. 26, 1892.

The General Market.—Throughout the week the railroad stocks have been only downward in their course and weakness has prevailed on all sides. The industrials on the contrary have been pretty strong, and withstood with considerable strength any efforts directed against their maintaining a good price. The whole market, however, has shown evident signs of weakness, and the rise in sterling exchange has had its usual tendency to unsettle prices. The bugbear of gold exports will from now on prove an important factor in the condition of market values, as the outgo has already commenced, with an earlier movement than has ever been known before. The bears have directed their efforts against nearly all the Granger stocks on the list, and upon reports of decreased earnings, and any other fiction that will serve for the moment, they have managed to record a considerable loss in values for the week. Copper stocks have had a strong and active week at top figures. Boston & Montana and Osceola vying with each other in activity and first place at about 35. The Boston bank statement for the last week was so favorable as to make the money market even easier than ever. Each item in the statement shows a material increase: Deposits, $7,400,000; New York reserve, $1,390,000; loans, $79,700 The clearing house rate broke to 3½ per cent. Time loans are generally 5 to 6 per cent., and call money 4 to 5 per cent., mostly at the latter rate.

The electric stocks have had a quiet, uneventful week. There has been a feeling in some quarters that the General Electric Company was using too much money, and the issue of the new bonds for ready capital has not been received favorably on all sides. The price of the stock has not materially changed on the few sales that have been made, but shows a slight loss for the week. The preferred stock remains quiet and strong with a decided evenness whatever the reports may be. The books of the common stock are closed until Dec. 7th to facilitate the allotment of the five per cent. bonds to the stockholders.

Westinghouse maintains its strength with very light sales and all raids that are made on other industrials seem to leave this stock very much alone. The quotations are very little changed from those of a week ago, though at closing prices it shows a loss at 36.

The telephone stocks are very strong this week, especially Erie, which has made an advance of six points to 53¼. This is due to the particularly favorable outlook of the company on account of the increased facilities for long distance work in its territory, and the easy sale of bonds which will be used to make still further extensions. Bell reached 209 this week on the usual small sales.

Rumors are rife on Fort Wayne to the effect of something in connection with the General Electric Company. The stock is strong at 13½, and an attempt is being made to put it much higher, but it moves slowly, on account of the meagre reports that the company publishes of its condition and business.

West End Railway shows a slight loss from last week's figures, the influence of the good report being only temporary in its effect on the stock.

The New England Printing Telegraph Company at a recent meeting of the directors in Boston elected the following Board: President, Charles O. Billings; John V. Lewis, Nathaniel J. Rust and J. K. Souther, all of Boston; John R. Reed Westfield, Mass.; Abner McKinley and P. S. Jennings, of New York. Many of these are new acquisitions, and have put a large amount of money into the company, sufficient to assure the success of the plans for the extension of its lines. Work is now under way building the lines from the present terminus in Danielsonville, Conn., to New York. The company is doing a commercial business from Boston to Providence, Woonsocket and Danielsonville and expects to operate to New York within four months, if the weather permits the completion of the lines in that time.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series Co.....	sh	40,000	9¼	....	9	10
Thomson-Houston Elec.—Series D.....	sh	120,000	8	7⅞	7¾	8
Thomson Elec. Weld.....	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	....	....	....	10
Westinghouse Elec.—New Com.....	..	6,000,000	37⅞	36	36	37
Westinghouse Elec.—Pfd.	..	4,000,000	50	49¼	49½	50
General Electric.....	..	30,067,200	114	112¼	112	112½
" " Pfd ...		4,136,300	118	117	117	117½
Fort Wayne Elec.....	25	4,000,000	13⅛	12⅛	13	13¼
Fort Wayne Elec.—Ser. A.	sh	80,000	....	....	7½	8
Detroit Elec.....	20	750,000	5	4¾	4½	5
West End St. Ry. Co.—Com	50	7,150,000	73¼	73	...	73½
West End St. Ry. Co.—Pfd	50	6,400,000	87¼	87	87	87½
American Bell Tel	100	15,000,000	209	207	208	209
Erie Tel. & Tel. Co.....	..	4,800,000	53¼	47½	51⅜	51⅝
Mexican Tel Co.....	10	1,280,000	1.00	....	.90	1.00
New Eng. Tel. & Tel. Co..	..	10,304,600	59½	58	58	59
Tropical Tel. Co.....	10	400,000	....	....	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.
Chicago.....	214	....
Central Union	....	58

Electrical Stocks:	Bid.	Ask'd.
Chicago Arc Light & Power Co.....	102¾	104
Chicago Edison Co....	170	..

NEW INCORPORATIONS.

The Credus Electric Company, of Milwaukee, Wis., capital stock $70,000, has been formed to manufacture electrical apparatus. The promoters are W. W. Bromley, W. F. Miller and T. K. Ewing.

The Kennedy Electric Company, Chicago, Ill., capital stock $100,000, has been formed to manufacture and sell devices and appliances used in electrical locomotion. Heman R. Powers, Lynden Evans and Frederick Arnd are the promoters.

The Mahoning Railway Company, Mahonington, Pa., capital stock $150 000, has been incorporated to construct and operate an electric railway. P. J. Scanlon, H. E. McMillin and Charles D. Johnston, all of Mahonington, Pa., are the promoters.

The Reynoldsville & Rathmel Electric Street Railway Company, Reynoldsville, Pa., capital stock $25,000, has been formed to construct and operate an electric railway. E. K. Arnold, J. S. Morrow and F. J. Black are the promoters.

The Lexington Light and Power Company, Lexington Va., capital stock $50, 00, has been formed to erect electric plant and supply power. L. H. Latham, R. E. Hutton, Baltimore, Md., and D. C. Humphreys and E. R. Carichoff are the promoters.

The Jefferson Light and Power Company, of Jefferson, O., capital stock $10,000, has been formed to manufacture and furnish light, heat and power. W. D. Packard, J. W. Packard, T. H. Thomas, Harmon Austin, Jr., and W. C. Pendleton are the promoters.

Jeannette & Penn Electric Street Railway Company, Jeannette, Pa., capital stock $30,000, has been formed to construct and operate an electric railway. A. J. Case, George W. Knappenberger and J. R. Spiegel, all of Jeanette, are the promoters.

The American Motor Manufacturing Company, Denver, Colo., capital stock $10,000, has been formed to purchase, sell, operate and construct electric motors and other apparatus. Samuel P. Raber, Eugene O. Dawson and M. G. Evans, of Denver, are the promoters.

The Electric Company, Canton, O., capital stock $10,000, has been formed to manufacture and deal in all kinds of electrical machinery and supplies, etc. Albert Hoeffer, M. P. Hoeffer, John C. Skelton, L. H. Skelton, John Karrer, A. P Gould and E. W. Gould are the organizers.

The F. P. Little Electrical Construction and Supply Company, of Buffalo, N. Y., capital stock $100,000, has been formed to purchase and sell electrical machinery and to construct electrical works. Sylvester F. Eagan, Franklin P. Little and Peter P. Miller, all of Buffalo, are the incorporators.

The Ashland, Locust Dale & Centralia Electric Railway Company, Ashland, Pa., capital stock $60,000, has been formed to construct and operate an electric railway from Ashland to Centralia and Mt. Carmel, in Pennsylvania. J. F. Bailey, Joseph H. Cafrode and F. E. Bailey are interested.

The Martinsburgh Electric Light and Power Company, Martinsburgh, W. Va., capital stock $50,000, has been formed to construct and maintain electric plants and lines, furnish light heat and power, etc. Thos. A. Noble, S. J. Macfarren, and Richard Ficklin, all of Pittsburgh, Pa., are the incorporators.

The Lehigh Traction Company, Hazleton, Pa., capital stock $10,000, has been formed to construct and operate motors, cables, electrical appliances and machinery for supplying power to passenger railways, etc. Geo. R. Redwood, D. A. Fell, Jr., and H. A. Fuller, all of Wilkesbarre, Pa., are the promoters.

The Lancaster Carbon Company, Lancaster, N. Y., capital stock $5,000, has been formed to manufacture and sell electric carbon points and other electrical appliances. Andrew Cant, 384 Prospect avenue, Reuben J. Getz, 131 Morgan street and Wm. C. Hodge, 60 Hodge avenue, all of Buffalo, are the promoters.

The New York Development and Manufacturing Company, New York City, capital stock $20,000, has been formed to manufacture and sell electrical apparatus. Wm. G. Parsons, 64 Hanson place, Brooklyn; Franklin A. Coles, Glen Cove, L. I., Otis Wilkinson, Hull avenue, Bedford Park, N. Y., are the incorporators.

The General Electric Launch Company, Camden, N. J., capital stock $30,000, has been formed to manufacture, use, buy, sell, etc., electrical batteries, motors, switches, etc., for use in connection with the operations of the company. H. Weston, C. A. Senior, Jr., of New York, and W. R. Robins, Ozone Park, N. Y., are the promoters.

The Emme Ground Electric Generator Company, of San Francisco, Cal., capital stock $1,000,000, has been organized to deal in patents for generating electricity and to furnish light, heat and power. Michael Emme, Oakland; Geo. W. Peterson, Chas. P. Harris, Alpheus Bull, Jr., H. D. Hawks, all of San Francisco, are the incorporators.

The Warsaw Gas and Electric Company, of Warsaw, N. Y., capital stock $50,000, has been incorporated to supply light, heat and power. This is a consolidation of the Warsaw Electric Light and Power Company and the Citizens' Gas Light Company. George C. Otis, Moses G. Rowe and Elbert E. Farman, all of Warsaw, are the promoters.

The Lake Cities Electric Railway Company, Michigan City, Ind., capital stock $300,000, has been formed to construct and operate street railways by electricity or otherwise, and to generate electricity for light, heat and power. Aretus W. Hatch, Willard C. Nichols, Andrew T. Hart, James C. Devor, and Edward McDevitt are the incorporators.

The Vibrating Electric Gold Trap Company, of Denver, Col., capital stock $400,000, has been formed to manufacture, lease and rent machinery for extracting or saving metals from ores, etc. Thos. H. Wygant, Jr., secretary of the Globe Building and Loan Association, of Denver, Colo.; Albert J. Stoddard and Howard Van F. Furman, are the promoters.

The Bradford Self-Closing Telegraph Key Company, of Clinton, Me., capital stock $500,000, has been formed to manufacture and deal in electric telegraph keys, especially the invention known as the "automatic circuit closer for telegraph keys." W. T. Haines, Waterville, Me.: Chas. W. Bradford and Howard W. Dodge, both of Clinton, are the organizers.

The California Electric Railway Company, capital stock $1,000,000, has been organized to construct and operate an electric railway for passengers and freight, etc. It is to be a single track, narrow gauge, and it is to run from Stockton to Wallace, 12 miles. H. J. Corcoran, E. R. Hedges, I. S. Bostwick, Jos. Fyfe and S. D. Woods, Stockton, Cal., are the promoters.

The Sacramento Electric Light and Power Company, San Francisco, Cal., capital stock $1,500,000, has been formed to erect and operate works and apparatus for electric and other modes of lighting and heating, etc. Albert Gallatin, San Francisco; Aldrew J. Ralston, Horatio P. Levermore, Chas. E. Levermore and Joshua Barker, all of Oakland, Cal., are the parties interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Nov. 28, 1892.

Meeting of the New York Electrical Society.—The next meeting of this society will take place in Prof. Chandler's lecture room, Columbia College, Forty-ninth street and Madison avenue, on Thursday, Dec. 1, at 8 P. M. Prof. Edwin J. Houston, of Philadelphia, will deliver a lecture on the "Magnetic Field," which will be illustrated by lantern projections and experiments.

H. N. Bates & Co. have issued a neat circular to the trade setting forth the advantages of their patent turned shafting. They claim for this that it is perfectly round, straight and true to size, entirely free from imperfections of the cold-rolled or drawn article. Key-seating will not warp, buckle or twist this shafting out of true, as is generally the case with the cold-rolled or drawn article. This company makes a specialty of power transmitting machinery.

The New York Central Railroad has adopted the Burnham & Duggan railway chair to be used in all its construction through the various cities in which its line runs. The fundamental peculiarity of this chair is its continuous inside angle bar. It can be placed in position permanently, and the rails removed by driving back the malleable iron plate. A chair is used on each end of each tie, and six larger chairs are required for each 30 feet to accommodate the outside angle bar.

Chief Engineer Nevins, of the Brooklyn Fire Department, has addressed a letter to G. T. Paterson, president of the German American Insurance Company, indorsing a system of thermostats in connection with the fire department. He states that such systems are now in use in New York, Chicago, Cincinnati and Boston, and have proved very beneficial and given prompt alarm to the fire departments, and requests President Patterson to use his influence in having such a system adopted in all large warehouses and buildings.

L. H. H.

ALBANY, Nov. 26, 1892.

An electric light plant is one of the possibilities for Ilion.

Mr. William Dennin, of the Albany Railroad, has resigned, and Mr. Joel Rathbone has been appointed in his place.

The Manhattan Oil Company has begun an action against the Cooperstown Illumination Company for the appointment of a receiver.

The Citizens' Electric Railway Company, of Corning, has been organized with a capital stock of $100,000. It is the intention to operate about six miles of track.

Storage Battery Line Not to Be Built.—The scheme to build an electric railroad upon the storage battery system between Syracuse and Liverpool has fallen through.

The Johnstown, Gloversville & Kingsboro Railway Company has filed its quarterly report: It shows gross earnings, $5,836.05; net earnings, $3,017.18; gross income, $3,025.18; net income $2,876.47, against $983.82 last year; assets, $70,757.

The Cayadutta Electric Railroad Company made a motion for a modification of the injunction order restraining the city of Johnstown from granting the company a franchise which has been denied by Judge Kellogg, of Schenectady.

Railroads at War in Elmira.—The Erie Railroad has manifested serious objections to the West Side Street Railroad Company stringing its trolley wires over its tracks. Several attempts to put up the wires were made and each time they were cut down by the Erie people.

The Fonda, Johnstown & Gloversville Railroad Company has made the following quarterly report: Gross earnings, 1892, $73,220—1891, $55,071; operating expenses, $38,913—$33,808; net earnings, $34,307—$24,264; gross income, $35,046—$24,619; net income $24,153—$13,502; cash on hand, $23,015; profit and loss, $192,898.

The Albany Railway Company, which now owns and operates the Watervliet Turnpike and Railroad Company, has reported to the railroad commissioners its operations for the quarter ending September last. The net income for the quarter is $37,885 as against $13,790 for the same period in 1891. The assets of the company are given as $1,662,051 and the funded debt $729,393.

The Glens Falls, Sandy Hill & Fort Edward Street Railroad Company has filed its report for the quarter ending September 30 with the State Railroad Commissioners. The road's gross earnings were $12,072.48 as against $11,578.51 during the same period in 1891. The operating expenses were $5,737 and the net earnings $6,335.42. They were $5 586.21 and $5,992.20 respectively, during the same period last year. The road's other income was $338.74; fixed charges, $1,860.21, and net income, $4,814.95. The general balance sheet shows assets of $238,614, including $233,155 cost of road and equipments and $743 cash on hand. The capital stock is $120,000; funded debt, $100,000, and $2,762 profit and loss surplus.

The Troy & Lansingburgh Railroad Company has leased the Troy City Railroad Company. Besides its own road the Troy & Lansingburgh company leases to the Troy City management the line and equipment of the Troy & Cohoes Railroad, Lansingburg & Cohoes Railroad and Waterford & Cohoes Railroad during the time of the existence of the respective charters at the annual rental of $70,000 a year. The State Railroad Commission has granted the application of the Troy City Railroad for an increase in capital from $400,000 to $2,000,000. The contract states that the indebtedness of the Troy & Lansingburgh company does not exceed $300,000. The bulk of the stock will be taken by Edward Murphy, Jr., Charles Cleminshaw, Anthony N. Brady, James O'Neil and Peter McCarthy. The routes now under the control of the Troy City railroad comprise all the street railways of Troy, Green Island, Waterford, Lansingburgh and Cohoes.

R. V. T.

PHILADELPHIA NOTES.

OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, PA., Nov. 26, 1892.

Mr. C. H. Stanton is very busy supervising the work of his new electrical salesroom.

The LaRoche Electrical Works is working its men day and night, and even at that cannot keep up with the orders daily coming in.

The many friends of John A. Brill, vice-president of the J. G. Brill Co., car builders, Philadelphia, will be pleased to learn of his entire convalescence and his return to his office business.

The Helios Electric Company is doubling its plant, and has already made arrangements for machinery to duplicate its present capacity, which is due to the large demand for its new arc lamps.

Inspection of Queen & Co.'s Laboratory.—Previous to 1890 very few electrical instruments were manufactured in this country. It became apparent to the firm of Queen & Co. about that time, however, that this business offered a promising field and they entered it in a small way. Up to the latter part of 1891 the mechanical work was done in the shops of Queen & Co. and the instruments then sent, in great part, to the Mather Electrical Company at Manchester, Conn., where the electrical work upon them was done under the supervision of Wm. A. Anthony. By the end of 1891 the business had assumed such large proportions that it became undesirable to separate longer the manufacturing and it was decided by Queen & Co. to establish a laboratory of its own in which its electrical work could be done. This laboratory was formally started about Dec. 1, 1891. On Saturday of last week, nearly a year after the establishment of this laboratory, the Franklin Institute and other friends of the firm, composed of prominent scientific and business men interested in electrical matters, visited the laboratory at the invitation of the company. The usual operations were being carried on and an opportunity was given to all to inspect the method and style of work being done. About forty visitors in all gathered together in the afternoon and were divided into squads of eight or ten and shown the premises in detail, each squad being under the charge of one of the electrical staff. In this laboratory both ammeters and voltmeters are calibrated in large quantities. Here also are adjusted resistance boxes for numbers of measurements of all kinds, testing sets and ultimate standards of resistance; galvanometers, electrometers, etc., etc., are also standardized here. The laboratory is in charge of Mr. Elmer G. Willyoung, B. S., of the University of Michigan, and the staff is made up of himself and Mr. Nelson H. Genung, B. S., of Cornell, for two years instructor in physics and electrical engineering at that place; Mr. O. T. Louis, B. S., M. S., of Cornell, and Mr. E. S. Cary, A. B., of Haverford. The laboratory is thoroughly equipped with all the best forms of instruments. For the very highest grade of work there has been built a small brick building 50 ft. away from all other buildings. This was especially erected for the purpose, and is entirely free from iron or any magnetic substance. The walls are double, having a 4-in. space between, which is filled with sawdust, to keep the temperature of the room very uniform. In this room are a number of square brick piers, built three feet into the ground and filled in with conglomerate, upon which are rested the standard instruments. The building is heated by steam, the coils being all brass. The policy of the laboratory is to encourage its employés in all possible manner to learn. A good library is provided and all the leading American and foreign periodicals are also received. Meetings are held every other week in the evening under the auspices of the firm, and at these meetings abstracts of work which had been brought out in the leading periodicals and also reviews of new books are presented. After having visited all the departments of the laboratory the party repaired to a large room in the main building, where a very nice luncheon was served.

N. D. W.

PITTSBURGH NOTES.

PITTSBURGH, Nov. 26, 1892.

The Pittsburgh Traction Company from its annual reports has carried about 8,000,000 people during the year and its gross earnings were $4,000,000.

The West End Passenger Railway Company of this city will begin operating its lines electrically by the first of December. All of the work on the road is finished with the exception of the switch at the corner of Fifth avenue and Market street, the laying of the track and the wiring over the Point bridge. The cars are of the Brill make and equipped with 15 Westinghouse single reduction motors.

A Street Railway Week.—A number of the local companies held their annual meetings this week and these gatherings have become very interesting of late. At the annual meeting of the Citizen's Traction Company reports were read, showing that the company had carried 13,902,649 passengers on cable, electric and horse cars. The gross receipts of the road were $690,299 and the net earnings $227,591. This is the company which is now building a branch to its main line, that will run from the East End to Wilkinsburg.

The Second Avenue Passenger Railroad Company is a purely electric road, operating 25 cars with the Westinghouse system of single reduction motors. Just about a year ago the company's car barn and its entire equipment were destroyed by fire. This was on the night before Thanksgiving day. On that day the company had to do business with cars that were lent by the other street car companies in the city. In spite of this disaster, however, and in spite of the fact that the company has since got an entirely new equipment, the earnings of the year were $126,000. The company now contemplates laying the Johnson rail along the entire length of its lines.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 26, 1892.

M. W. Brown & Co., 620 Atlantic avenue, have been appointed exclusive agents for the Washburn & Moen's Salamander wire for Boston and suburban districts.

Col. Wheeler, manager of the Wheeler Reflector Company, Boston, has gone to Chicago in the interests of his company, and expects to do considerable business before he returns home.

Mr. T. W. Phillips, secretary of the Providence Steam Engine Company, Providence, R. I., advises us that the company is doing very satisfactory business at present, having orders ahead for several months.

The Sampson Cordage Company has added a 50-h. p. Mather dynamo, which is to be operated by belts made by the Main Belting Company, of Philadelphia. The whole plant now is operated by water power.

Henry F. Holland has been appointed New England agent of the National Electric Company, of Eau Clair, Wis., with offices at 620 Atlantic avenue, Boston. Mr. Holland expects to carry a full line of National apparatus.

The W. A. Harris Steam Engine Company, of Providence, R. I., reports that the demand for engines has become so great that it is found necessary to work a full force at night as well as day, in order to keep up with the demands.

Messrs. W. R. Fleming & Co., the well known engineers and contractors of New York, have opened a branch office at 620 Atlantic avenue, Boston, under the management of Mr. W. W. Jones, where they will be pleased to meet their friends and furnish estimates on anything in their line.

Bay State Belting Company, Boston, Mass., manufacturers of India tanned dynamo belting, say the leather from which these belts are made is tanned by their celebrated Indian tanned process from carefully selected steer hides only. All the special advantages which have made their Indian tanned laces so famous apply to the belting made from this tannage of leather. This belting is especially adapted for use where a strong pliable high speed is required, such as for dynamos, cones, woodworking machinery, race and stripper belts. They are well adapted to run in damp places, and owing to the great tendency of this leather to hug the pulley can be run much looser than the ordinary belting.

The Haverhill West Parish citizens have held an enthusiastic meeting to discuss a project for an electric road from Salem Depot to Haverhill, passing through Ayers village and entering Haverhill either over Becker Hill or Mt. Washington. The sense of the meeting was that an electric railroad would pay. The old hat factory, it was suggested, could be remodelled into a power house and car repository. The project was strongly supported by residents all along the route. A committee of five property holders is to be appointed (C. H. Tarleton, chairman) and empowered to appoint the other four, to consult with the proprietors of electric roads in regard to extending their lines to the town of Salem, N. H. At the meeting it was stated that President Shaw, of the Amesbury road, had said that if it could be shown to him that it would pay the line would be built at once.

W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 26, 1892.

Mr. John L. Gans, the traveling representative of the Sunbeam Incandescent Lamp Company, has been in Chicago for the last few days, during the absence of Manager Terry in the East.

The Central Electric Company has just taken the agency for a combination tin shade, both flat and cone shaped. These shades are under patent by F. H. Soden, and will be known as the "Central Combination Shades."

The Electric Appliance Company has been engaged for the past few weeks in rearranging and enlarging its store and office to make room for the larger working force necessary to take care of the rapidly increasing business.

Mr. George Cutter, of Chicago, has secured the Western agency for Pass & Seymour's special china goods, including the very handsome switches which have been so highly admired by architects wherever artistic work is desired.

Testing a Submarine Boat.—Mr. George C. Baker's submarine boat was informally tested on Lake Michigan, near South Chicago, last Saturday. Two members of the Torpedo Board of the United States Navy were present, and with Mr. Baker witnessed the trial from a tug.

Mr. F. S. Terry, manager of the Electrical Supply Company, Chicago, and Mr. A. S. Terry, manager of the Sunbeam Incandescent Lamp Company, Chicago, spent their Thanksgiving week in Connecticut, visiting their parents and relatives, and having a short respite from business cares.

Mr. W. S. Reed, the well known mechanical and electrical engineer, has formed a corporation known as the W. S. Reed & Company for the purpose of installing both electric light and railway plants and also water works in western cities. Mr. Reed has moved from the Monadnock Block into very handsome offices on

the fifth floor of "The Rookery," and there will be glad to meet his many friends.

The Chicago Association of Stationary Engineers, No. 1, of Illinois, will give their Eleventh Annual Ball at the Second Regiment Armory, corner Washington Boulevard and Curtis street, on Wednesday evening, Dec. 14. As the proceeds will be devoted to the library fund, it is trusted that the attendance will be unusually large, and the various committees are making every effort to make the affair as successful as possible.

Mr. Charles Wilson, the Northwestern rapresentative of the Babcock & Wilcox Company, with headquarters at Minneapolis, Minn., has secured a contract for a battery of boilers to be used in the Negaunee & Ishpeming Street Railway and Electric Lighting companies. Mr. Wilson has been very successful in the introduction of these famous water tube boilers in the Northwest and is to be heartily congratulated on the numerous sales he has effected.

Mr. William M. Willis, of the General Electric Company, Chicago, read an interesting paper on the "Compound Winding of Generators from a practical Standpoint" before the members of the Chicago Electric Club, at the first literary meeting held this season which is reprinted elsewhere in this issue. Some forty-five members were present, and much interest was manifested in the discussion, which together with the paper appears elsewhere in our columns.

Mr. Henry S. Pruyn, of Hoosic Falls, N Y., is exhibiting an improved system of elevated street railway in Chicago. The cars are built to run on a single rail, which is suspended on iron posts, the wheels instead of being under are within the body of the car. On each side of the rail are two smaller wheels which convey current to the motor and at the same time serve to keep the car on the track. The cars are only six feet high, and offering a minimum resistance to the air are able to run at a very high rate of speed. Mr. Pruyn will make an effort to have his system adopted upon the World's Fair grounds.

The Nuttall Railway Supply Company, which has been appointed the general western agent of the R. D. Nuttall Company, has established its offices in suite 801-802 Monadnock Block, where treasurer Edward H. Harrison has everything in readiness to receive visitors, and also to hear from electric street railway companies desiring supplies in his line. Mr. Harrison is so well known to the electrical fraternity, not only in New York where he was formerly connected with the Edison company, and later with the H. Ward Leonard Company, but also in the West where he resided prior to his residence in New York.

The Standard Electric Company, Home Insurance building, Chicago, is meeting with the most gratifying success in the sale of arc lighting apparatus, more especially in the larger cities, where lighting companies are tied up by previous contracts, and where the citizens are desirous of having the benefit of an additional central lighting station. This was particularly noticeable in Cincinnati, where they secured one order for a dynamo capacity of some 2,500 arc lamps. Again the decided interest the Standard Electric Company has taken in the World's Fair since the inception of this great national enterprise has been of material assistance in consummating certain work, for, among the electrical industries there is probably no larger stockholder than the Standard Electric Company, who were among the first to subscribe liberally to the World's Fair stock.

F. DE L.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Nov. 16, 1892.

Parsons Steam Turbine.—About six or seven months ago Prof. Ewing conducted an elaborate series of tests on the Parsons steam turbine which gave results astonishing to the engineering profession. Within the last few weeks Prof. Ewing has conducted a further series of tests with a view of bringing out the increased efficiency due to slight superheating and minor modifications. The tests made in January last showed the steam consumption in the case of a condensing steam turbine connected to a 100-kilowatt alternator of 37 pounds per kilowatt hour when running full load and of 43 pounds per kilowatt hour when running at one-third load. The latest tests show an economy of about 27 per cent. on these figures.

An Electric Lighting Fatality.—A fatal accident happened last week to an employé of the House to House Electric Light Company, who at the time was hauling at an insulated cable contained in an iron tube, previous to connecting a private house with the company's mains. From the evidence given at the inquest it appeared that the cable in question had a 2,000-volt current on at the time, and that the deceased was not wearing the india rubber gloves served out by the company; it also came out that the rubber of the cables had been in many cases eaten away by rats, so that it was probable that in hauling the cable out of the tube the unfortunate man's bare hand came into contact with the copper conductor. The company was exonerated from all blame.

Gas v. Electricity at Carlow.—Hitherto the rivalry between gas and electricity has been carried on in a more or less amicable fashion in this country and it has been reserved for the gas company of the insignificant Irish town of Carlow to commence an active campaign against the new illuminant. Several householders in Carlow, having substituted electricity for gas, continue to hold on to their meters so as to be able to fall back upon gas in case of a failure in the electric supply. The gas company has made a raid upon such householders and has also brought an action against one of them, with a view of compelling him to give up his meter. The judge without finally deciding the question raised, viz., the right of the gas company to refuse to supply the consumer so long as he pays for the amount registered, dismissed the case on the ground that the company had no right to remove the meter in question until they had cut off the connection with their mains.

The "Hydrophone."—During the past few days a party of naval and military experts have subjected an invention of Captain McEvoy, called the "hydrophone" to severe tests. The "hydrophone" is merely a submarine telephonic apparatus intended to give warning to the shore or to ships at anchor, of the approach of hostile vessels, such as torpedo boats. The submarine portion of the apparatus is a bell-shaped iron case 20 inches high and 20 inches in extreme diameter, weighing in all about 340 pounds; the top of the apparatus being fitted with a suitable vibrating diaphragm. It is said that the action of a propellor will set this diaphragm in motion at a distance of from one half a mile to a mile. The telephonic currents are "relayed" at the receiving station and can be made to give various warning signals. The trials off Fort Gilkicker (Portsmouth) are said to have been completely satisfactory.

Electric Traction on the South Staffordshire Tramways.—On Saturday last the Board of Trade inspectors visited the portion of the South Staffordshire tramways system which has been equipped with electric cars and the overhead trolley. The trial trips were a complete success. As this line presents one or two original features, a few particulars may be of interest. The generating plant consists of three compound condensing engines rope coupled to three Elwell Parker, two-pole drum-armature machines each giving 350 volts and 275 amperes at 450 revolutions. The trolley wire is 21 ft. above the road level, and is carried by compressed mica insulators, the feeders being run underground and coupled with the line at intervals of about half a mile. The most interesting feature of the system is perhaps the adoption of the *side* trolley. The trolley pole, which is a hollow steel tube, is on the top of the car, just out of reach of the outside passengers. A powerful upward thrust is obtained by means of six strong cyclindrical springs in tension connected on a tail bar. The radial motion, which is required to compensate the distance between the wire and the car, which varies from 13 to 3 feet, is obtained by allowing the trolley pole to radiate freely about the centre of the mast on which it is mounted, the trolley wheel itself being swivelled at its point of support, thus keeping parallel to the line as the pole swings, the top flanges of the wheel and the upward thrust of the springs giving the necessary tractive motion to the pole. The cars have been specially built to meet the condition of a 3½ ft. gauge and carry two 15 B. H. P. motors of the double magnet and circuit, drum armature single reduction type with helical gearing. The motor is required to run at 330 revolutions per minute for a car speed of 9 miles an hour.

Electricity Supply Charges.—The necessity under which all English electric supply companies lie of paying their way in the face of legislative restrictions and the keen competition of gas and oil is inducing our central station managers to encourage by all means in their power a *steady* consumption among their consumers and to discourage the connecting up of unnecessary lamps, which may at any moment be thrown upon the station when it can least afford to stand the load and thus either cause a severe strain upon the machinery or involve the maintenance in idleness for six days in the week of a large portion of the machinery. One method of going to work has been the sliding scale such as used in Leeds and elsewhere, which although theoretically very admirable is far too complicated to be generally appreciated. Another device is that of charging half price for current supplied during the day time; and in the case of the St. Pancras municipal station the short trial which has been given to this system is said to have demonstrated its practicability, although as a matter of fact each consumer when he wants to light up more than a certain number of lamps has to manipulate a switch. The Manchester Town Council, which under the advice of Dr. John Hopkinson has installed a station on the 5-wire system; proposes on the recommendation of the same gentleman to adopt a decidedly original method of charging. In a paper recently read before the Junior Engineering Society, Dr. Hopkinson drew a startling picture of the difference in cost per horse-power generated at a central station which ran throughout the year at top load, and at the same station when running for a year with no load but friction. The result of Dr. Hopkinson's cogitations is that at Manchester each consumer is to be charged a fixed sum per quarter for the privilege of being able to throw on the light at all times and the extrordinarily small amount of 2d. per kilowatt hour is to be charged for energy actually consumed. Taking the experience of the metropolis as a basis, the average consumer will, under this system, get his kilowatt hour for about 3½d. [Dr. Hopkinson's paper is reprinted elsewhere in this issue.—EDS. E. W.]

FRENCH NOTES.

The Telegraphic Bureaus in France.—Each year a number of new telegraph bureaus are established in France. The Minister of Commerce has authorized the establishment of more than 50 of these bureaus in various departments throughout the country.

The Telephone Building at Paris.—A large building especially designed for telephonic service is to be constructed in Paris by the Central Bureau of Posts and Telegraph. The apparatus will be so arranged that communication can be had with other portions of Paris, with the Provinces and with foreign countries The new service will be in operation about Jan. 1.

The Societe Internationale des Electriciens de Paris.—After an interval of some months this society held a meeting on the 9th of November. M. Picou spoke of the all-day efficiency of transformers and the means of improving it. M. Crouvé described his new electric fountain. M. Mascart announced that the subscription for the Central Laboratory of Electricity has reached more than 100,000 francs.

New Theory of Lead Accumulators.—An electrician of Rouen, M. Bidard, has made a great number of experiments upon accumulators and has advanced a new theory. According to him during the charge a sulphide and binoxide of lead are formed; during the discharge the sulphur and the oxygen are recombined so as to form dilute sulphuric acid. Storage takes place because neither the sulphur nor the binoxide of lead are attacked by the dilute sulphuric acid.

The Telegraph in Andora.—A new telegraph line has been established between France and the little Republic of Andora on the Spanish frontier. This line, which is especially necessary in that country, blocked by snows in the winter, would have been installed a long time ago had it not been for the strong opposition of the inhabitants. The installation is at last completed, however, and the charge per word is five centimes, or one cent. The agents are natives but are employed by France.

News of the Week.

THE TELEPHONE.

Honolulu is said to have one of the best telephone systems in the world, almost every dwelling house being supplied with an instrument at the cost of only $16 per year.

The Northwestern Telephone Company, of Minneapolis, Minn., has nearly completed its large tunnel from the south end of the Wabash street bridge to College avenue. At some points the tunnel is over 42 feet below the surface.

The Inland Telephone and Telegraph Company has just completed a copper telephone line between Spokane, Cheney and Sprague, Wash., giving these places telephonic communication with all the cities and towns in Eastern Oregon and Northern Idaho.

THE ELECTRIC LIGHT.

Gallipolis, O., by a vote of 459 to 1 decided in favor of electric lights.

Utica, Ill.—It is stated that an electric light plant will be a paying investment in Utica.

The Ellyria (O.) Electric Light Company has added a new 1,000-light dynamo to its plant.

The Lansing (Mich.) Common Council has passed a resolution approving the action of the Board of Water-Works and Electric Light Commissioners in purchasing an electric light plant of the Lansing Gas Light Company for $45,000. The city comes into immediate possession and will furnish both street and commercial light.

THE ELECTRIC RAILWAY.

Corning, N. Y., is to have an electric street railway.

The New London (Conn.) Electric Street Railroad was put in operation on Wednesday of last week Considerable opposition has been manifested toward this project, but the crowded cars show plainly the sentiment of the general public in reference to the line.

The new electric street railroad from Old Point to Newport News, is now completed. The line was not permitted to enter the corporation limits, as the authorities objected to the trolley system, and passengers have to be transferred at that point to horse cars.

Steps on Electric Cars Too High.—Considerable complaint is made by ladies who travel on electric cars in regard to the height of the step, and many narrow escapes from falling are reported. The floor of these cars are somewhat higher than that of the ordinary horse cars on account of the motors. There seems no way to avoid this unless it is by making two steps instead of one.

The Broadway Railroad Company, of Brooklyn, N Y., which was purchased about two months ago by Drexel, Morgan & Co., has changed the policy of its management, and the board of directors has decided to substitute electricity for horses, the trolley system to be used if possible. The company has been applying to property owners for permission to string wires along the route and the consent of nearly $1,000,000 worth of property has been obtained. To the present management the trolley is almost a necessity. They own the electric road from East New York to Jamaica, and it was to obtain an outlet for this road that they bought the Broadway line, which will give them direct communication from the Broadway ferries to Jamaica.

The Consolidated Street Railway Company, of Worcester, Mass., has been purchased by New York, New Jersey and Philadelphia capitalists, the same parties who own the North Shore Traction lines at Lynn. The price paid, it is stated, is $200 a share for the 7,000 shares. It is the intention to form a corporation under the New Jersey State laws with $3,000,000 common and $2,000,000 preferred stock. The preferred stock will be accumulated six per cent. dividends security. The $2,000,000 received for the sale of the preferred stock is to be used in the purchase of the stock of the Consolidated Street Railway Company. That company now operates about 25 miles of street railways, only four of which are operated by electricity. About $450,000 will be needed to equip the road with electricity, and $150,000 to pay off the funded debt.

LEGAL NOTES.

Damages for Injuries Received.—A boy received injuries from having been run over by a street car, with the ordinary consequences of pain, etc., and a permanent limp and incapacity to straighten his leg. The Supreme Court of Missouri holds that $3,000 damages was not excessive.—(Buck *v.* People's Street Ry. and Elec. Light and Power Co., 18 Southwestern Reporter, 1090.)

Electric Light Company Enjoins Another from Erection of a Parallel Line.—In Alabama, in an injunction suit by one electric light company against another, the bill alleged that defendant was about to erect its wires along the streets and alleys on which complainant's wires were located, and to place them in such close proximity to complainant's wires as to do irreparable injury to complainant, and greatly to endanger the lives of its servants. The Supreme Court rules that the answer, which merely denied that danger would ensue "with a reasonably prudent management of complainant s system of wires," was insufficient to authorize a dissolution of the temporary injunction.—(Consolidated Elec. Light Co. v. People's Elec. Light and Gas Co., 10 Southern Reporter, 440.)

Poles and Wires and Appurtenance of the Premises of a Company.—In Kansas an electric light and power company owned land, on which was a building and machinery for generating electricity, and it had a franchise from a city to use its streets for the erection of poles on which to stretch wires and suspend lamps to furnish light for the city. Poles were purchased from plaintiff, planted in the streets, wires and lamps were placed thereon, and all connected by the electric light wires with the machinery and premises of the company. The Supreme Court decides that the poles and wires were an appurtenance of the premises of the company, within the statute providing that a person who, under contract with the owner of land, shall " . . . furnish material for erecting . . . any . . . appurtenance of any building, . . . shall have a lien upon the whole piece or tract of land the buildings and appurtenances;" and plaintiff was entitled to a lien on the premises.—(Badger Lumber Co. v. Marion Water Supply Electric Light and Power Co., 29 Pacific Reporter, 476.)

State Cannot Tax Capital Stock Invested in Patent Rights.—So much of the capital stock of a corporation as is invested in patent rights granted by the United States is not taxable by the State. This is so because taxation of it would restrain and interfere with a right granted by Congress in the exercise of power exclusively committed to it by the Federal Constitution, that instrument giving it power to promote the progress of science and useful arts by securing for limited times, to authors and inventors, the exclusive right to their respective rights and discoveries. Such a right would be exposed to serious danger if every State could tax it at will, either directly or by means of a tax upon capital stock. In fact it could easily be destroyed by exercising the legislative power of classifying subjects of taxation, and putting together in one class all corporations whose capital stock was invested either in whole or in part in patents granted by the United States, and then taxing them at a different rate from all other corporations.—(Commonwealth v. Westinghouse Electric and Manufacturing Company, Supreme Court of Pennsylvania, 24 At. Rep., 1,107.)

Rights of Owners of Patent Who Combine with Other Manufacturers.—The fact that a corporation or person owning letters patent upon a particular article or kind of machinery has entered into a combination with other manufacturers thereof to secure a monopoly in its manufacture and sale, and to that end has acquired all the rights of other manufacturers for the exclusive sale and manufacture of such articles or machines under patents, will not entitle a stranger to the combination to enjoin the corporation from bringing any suits for infringement against him or his customers. Such a combination may be an odious and wicked one, but the proposition that a person while infringing the rights vested under letters patent of the United States is entitled to stop the owner from bringing or prosecuting any suit therefor, because the owner is an obnoxious corporation and is seeking to perpetuate the monopoly which is conferred upon it by its title to the letters patent, is a novel one and entirely unwarranted. The party having such patent has a right to bring suit on it, not only against a manufacturer who infringes, but against dealers and users of the patented article, if he believes the patent is being infringed; and the motive which prompts him to sue is not open to judicial inquiry. If the corporation had brought suit for some breach of contract or violation of its alleged rights, founded upon the combination agreement, then it might become pertinent to inquire into the character of the combination, and ascertain whether the courts would enforce any rights growing out of it. But in a

suit brought for the infringement of a patent by the owner, any such inquiry, at the behest of the infringer, would be impertinent.—(Strait v. National Harrow Co., U. S. Circuit Court, 51 Fed. Rep., 819.)

PERSONALS.

Mr. James R. Watt, travelling salesman for the Berlin Iron Bridge Company, East Berlin, Conn., and Miss Louise E. Allemeyer, of Meriden, Conn., were united in wedlock at the home of the bride on Wednesday, Nov. 23

Mr. W. I. Barker, well known among New England electrical people, died at the Quincy House in Boston, of apoplexy, on Wednesday of last week. At the time of his death Mr. Barker was manager of the New England office of the *Electrical Review*. It will be remembered that he once represented The Electrical World in New England, and that he was afterward manager of the Philadelphia office of the same journal.

Mr. D. H. Ogden will hereafter represent The Electrical World in Chicago and the West. Mr. Fred DeLand having retired with a view to entering business for himself. Mr. Ogden's long practical experience and wide acquaintance in the Western Territory eminently qualify him for the position of manager of The Electrical World's Western office. Mr. DeLand, who has faithfully discharged the duties of this position for several years, has many friends throughout the West who will gladly wish him the best of success in any undertaking in which he may engage.

Mr. L. H. Hart, after nearly three years' service in the business department of The Electrical World, has resigned his position to engage in trade journalism on his own account. Together with Mr. H. M. Swetland, the proprietor of *Power*, Mr. Hart has purchased the *Hot Water and Steam Fitters' Register and Bulletin*, of Boston, and will continue that publication in an enlarged form as *Heating and Ventilation*, with headquarters in New York. On Saturday last Mr. Hart's associates on The Electrical World staff expressed their good will by presenting him with a handsomely engraved society charm. Mr. Hart is widely known among our advertisers in the East, many of whom will doubtless hear from him in his new position.

MISCELLANEOUS NOTES.

The National Electric Light Association will hold its sixteenth convention in the Bell Telephone Building, St. Louis, Mo., Feb. 28, and March 1 and 2, 1893.

Portrait of Cyrus W. Field.—We have received from the Direct United States Cable Company, 40 Broadway, New York City, a handsome steel engraving of the late Cyrus W. Field.

Cleveland, O.—It is reported that the Cleveland company, the local Brush company and the General Electric Company have formed a combination which is to be backed by the General Electric Company, of New York.

Electricity in Farming.—Electricity is being used in the vicinity of Old Point Comfort to transfer farm products from near Hampton to the government wharf by electric motors placed on the flat cars and the loaded cars attached.

Explosion of a Car Heater.—The heater on the pay car of the Knoxville, Cumberland Gap & Louisville Railroad exploded on Saturday of last week, and injured a number of persons, one of whom will probably die. When the electric car heater is introduced all this danger will be obviated.

Industrial and Trade Notes.

The Buckeye Electric Company, Mail and Express Building, New York City, reports business very good.

The Penhyrn Slate Company, of 101 East Seventeenth street, New York City, L. E. Lefferts, manager, reports business very good. This company manufactures switchboards, and general slate work.

The Security Insulator Company, 136 Liberty street, is meeting with great success in the sale of its porcelain specialties, and is about to add several important novelties to its line which should be well received by the trade.

Important Notice.—All communications regarding, and orders for, railway line material manufactured by the Lieb Machine Works should now be addressed to the General Electric Company, full arrangements having been made to this effect.

The Railway Equipment Company, Pullman Building, Chicago, Ill., has issued its circular No. 18, which contains full descriptions and illustrations of the overhead parts manufactured by this company. The Railway Equipment Company has been so long in the field that the character of its goods is now well known by all street railway men. This company has also secured the sole privilege to manufacture Ahearn electric heaters.

McLeod, Ward & Co., of 91 Liberty street, New Haven are doing the wiring for the new Kellogg Building, 61 East Ninth street. There will be about 200 incandescents. They have also installed a half h. p. Bilberg motor to run a Gould pump, and a-half h. p. motor to operate a dumb waiter in the same building. Among other work that they have been doing of late is the installation in the factory of the New York Biscuit Company of one 2,000-light and one 750-light Bilberg dynamo, and a 100 h. p. Bilberg motor to operate one floor before the main engines are started in the morning. McLeod, Ward & Co. are also about ready to place on the market a new theatrical lamp to do the work of a calcium light at one-quarter the cost. The usual cost now is about $20 per night. The beauty of the new lamp is that it requires no particular experience to operate it. These lamps have already replaced the calciums at Proctor's, the Madison Square theatre and the theatre of the Manhattan Athletic Club.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

UNITED STATES PATENTS ISSUED NOV. 22, 1892.

22,017. (Design.) Design for an Electric Heater Casing; Mark W. Dewey, Syracuse, N. Y. Application filed Oct. 19, 1892. This invention consists of a case presenting at opposite sides two broad surfaces which have their marginal portions meeting at their edges, the case being perforated or formed with openings in the upper and lower portions of its sides and top and bottom walls.

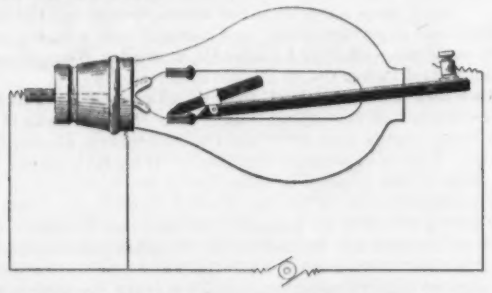
486,457. Incandescent Electric Lamp; Gustav A. Frei Springfield, Mass. Application filed March 14, 1892. In an incandescent electric lamp, leading-in or circuit wires, an incandescent filament, a joint for uniting the filament and the circuit-wires, consisting of a single tube one end of which receives an end of the filament and is thereto secured, and the opposite end receives an end of the leading-in wires and is fused to it. (See illustration.)

486,477. Insulating Chair for Rails; Frank E. Kinsman, Plainfield, N. J. Application filed Feb. 23, 1892. The combination with a railway-rail and its support, of an interposed sheet or plate of insulating material and an iron plate clamped on the insulation so as not to move with the rail. (See illustration.)

486,488. Electric Arc Lamp; W. O. Meissner, Chicago, Ill., Application filed April 13, 1892. In an arc lamp the combination of carbon rods with racks associated therewith, a shaft with two pinions thereon to engage such carbon rod racks, two oppositely faced ratchet wheels, two dogs on the ends of a pivoted cross bar, and means for rocking such cross bar, so that when the cross bar rocks the racks are engaged and move in either direction.

486,498. Lightning Arrester; Harry G. Osburn, Chicago, Ill. Application filed Dec. 28, 1891. The combination, with a charged circuit of a generator receiver, which provides a normally closed path connected to the circuit and having a ground connection and adapted to produce a current of sufficient electromotive force to counteract the current in the charged circuit.

486,506. Electric Switchboard; C. E Scribner, Chicago, Ill. Application filed Feb. 7, 1891. The switchboard consisting in the combination of strips of insulating material provided with corresponding notches, metallic pieces being mounted in said notches and said strips being placed together to form rows of rectangular plug holes, each having two metallic connections on opposite sides thereof.



No. 486,457.—Incandescent Electric Lamp.

486,507. Test System for Multiple Switchboards; C. E Scribner, Chicago, Ill Application filed Feb. 11, 1892. In a testing system for multiple switchboards the combination, with a device adapted to give a suitable response upon cessation of current through it of a source of electricity in a parallel circuit therewith and contact pieces constituting terminal of said parallel branch circuits, adapted to be applied to the contact pieces of a springjack, whereby it may be determined whether the said contact pieces of the springjack are short circuited or not.

486,524. Dynamo-Electric Machine; G. Baehr, Brooklyn, N. Y. Application filed Dec. 18, 1891. In a dynamo electric machine, the combination, with a ring armature, of a field magnet on each side, thereof, each magnet consisting of a vertical core wound with two coils, a space being left between them for the armature shaft bearings, pole pieces projecting from each end of the cores and surrounding the side and periphery of the armature, pole pieces of like sign being opposite each other, and the coils of the respective magnets being in separate circuits. (See illustration.)

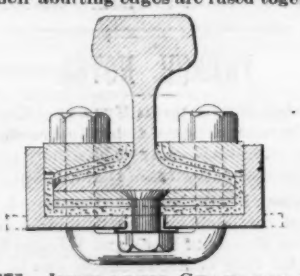
486,569. Electric Signaling Device; J. J. Ross, Detroit, Mich. Application filed Dec. 29, 1891. A circuit closer comprising a rocking bell, crank levers, oscillating levers, contact springs fixed to one of said oscillating levers, a sliding rod and wedge connected to the other oscillating lever, contact plates, stop plate or guards, the springs for holding said levers in their normal positions with the circuit broken.

486,573. Trolley-Wire Hanger; David E. Lain, Yonkers, N. Y. Application filed April 11, 1891. The combination in a trolley-wire hanger of grooved jaws that partly embrace the wire and means for clamping these jaws to the wire by moving them endwise together and on the wire.

486,575. Process of Electrically Reducing Refractory Compounds; Thomas A. Willson, Leaksville, N. C. Application filed April 20, 1892. The process of reduction of a pulverized metallic compound, which consists in first impregnating it with a reducing agent by saturating it therewith while the latter is in liquid condition and then subjecting the impregnated compound to the heating action of an electric current.

486,612. Electric Releasing Device; William R. Hewitt, San Francisco, Cal. Application filed Aug. 23, 1892. In an automatic releasing device, the combination of a swinging spring-controlled releasing arm having in its end a roller and a depressible trip-catch having a curved upper end behind which the roller of the releasing arm engages.

486,624. Electrical Method of and Apparatus for Forming Tubes; George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Sept. 16, 1891. The process of forming a metal tube, which consists in heating a bar electrically to a higher degree at its core or internal part than upon its exterior, coiling the bar in its heated state upon a mandrel with its successive turns abutting against each other, and permitting the coils to expand under the action of the internal heat, whereby their abutting edges are fused together.



No. 486,477.—Insulating Chair for Rails.

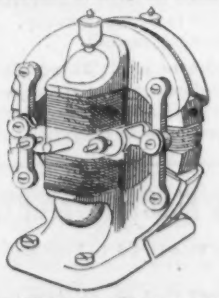
486,625. Electric Metal-Heating Apparatus; Geo. D. Burton, Boston, Mass. Application filed Oct. 21, 1891. The combination, in an apparatus for heating metals by electricity, of a main dynamo located at the central station and arranged to supply its alternating electric current to a sub-station, an exciter dynamo, also located at the central station and arranged to excite the field magnets of the main dynamo, an electrical converter located at the sub-station and arranged to receive the alternating current of the main dynamo and convert it into a current of lower potential, a pair of metal holders located in the secondary circuit of the converter and arranged to complete the secondary circuit through the bar placed in them to be heated, and adjustable resistance coil or apparatus located at the sub station where the converter is placed within reach of the operator, an electric circuit connecting said resistance coil to the exciter and arranged to regulate the electric current passing from the exciter to the main dynamo.

486,626. Electric Forging Apparatus; Geo. D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Jan. 13, 1892. In an electric forging apparatus, the combination of an electric converter provided with two converter rings constituting positive and negative poles, conductive brackets attached to them, standards connected with these brackets, two pairs of rollers journaled in these standards, and a mechanical bar feeder for feeding a bar between the rollers.

486,627. Electric Forge; Geo. D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Jan. 13, 1892. The combination of an electric converter provided with exterior rings constituting opposite electric poles, conductive brackets attached to the rings, arms connected with these brackets and clamps carried by the arms and having laterally extending jaws.

486,634. System of Railway Signaling; Thomas A Edison, Menlo Park, N J., and Ezra T. Gilliland, Boston, Mass. Application filed April 7, 1885. In a railway inductive signaling apparatus, the combination with a grounded line wire, a moving car, and an external condensing surface upon the car, of a transmitting inductive coil and circuit controller and a receiving telephone carried by the car and located in a ground connection from the condensing surface through the rails on which the car travels. (See illustration.)

486,643. Current-Director; James F McElroy, Albany, N. Y. Application filed Jan. 2, 1892. In a current-director, the combination, with a generator, of a divided circuit, a revolving armature, a fixed portion with which the armature coincides, and fixed coils in the branches of the circuit, arranged to embrace the extremities of the armature during the coinciding interval.



No. 486,524.—Dynamo-Electric Machine.

486,644. Current Regulator; J. F. McElroy, Albany, N. Y. Application filed March 21, 1892. In a current regulator having fixed contacts, the combination of a ratchet wheel carrying said movable contact two pawls adapted to actuate the same in opposite directions, by the movement of the armature, a spring for each pawl, an electromagnet for each pawl, arranged to throw such pawl into gear upon becoming active, means for moving the pawls, and means for closing said circuit through one or the other of said branches upon an increase or decrease from the normal strength in the circuit of the generator.

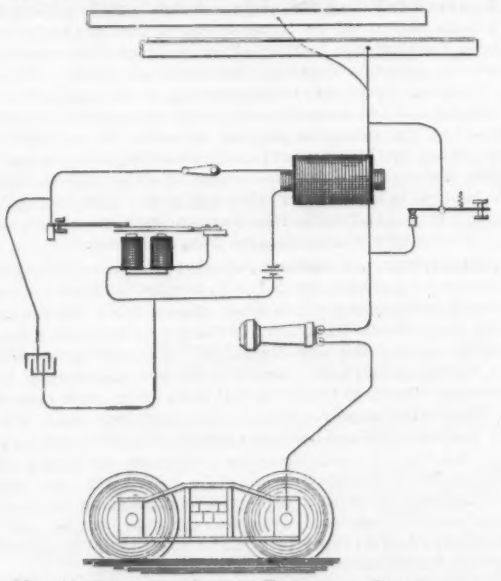
486,656. Carbon Brush Holder for Dynamo-Electric Machines and Motors; J. J. Wood, Fort Wayne, Ind. Application filed May 3, 1892. The combination with a brush-holder yoke and stud carried thereby of a carbon brush-holder mounted on said stud, having a spring pressing the carbon against the commutator, and reacting against the stud, so that it tends to twist the latter, and the stud where it passes through the brush-holder yoke being constructed with an angular shank fitted in an angular hole in the yoke with an intervening angular insulating bushing and a clamping screw for tightening it in place.

486,689. Electrical Measuring Instruments; E. Weston, Newark, N. J. Application filed June 4, 1892. In an electric measuring instrument, and in combination with an electro-magnetic system having a field of force which is substantially constant or not, varying with the strength of the current acting upon it, a loop conductor movable in said field under the influence of the current.

486,702. Successive Non-Interference Signal Box; W. E. Decrow, Boston, Mass. Application filed July 25, 1890. In a signal apparatus the combination with a break wheel and train, of a mechanical disabling device and three detents therefor, one controlled by a non-interference magnet, one by the train, and the third by the action of the apparatus in sending a signal.

486,757. Electric Arc Lamp; J. Brockie, London, Eng. Application filed Aug. 6, 1891. In the regulating mechanism of an electric arc lamp, the combination of two solenoids, the one having a core of coarse wire in the lamp circuit and an integral core linked to one arm of a lever, the other having a coil of fine wire in shunt to the lamp circuit and a divided core, part of which is linked to the opposite arm of the said lever, which lever is linked to the carbon feeding device.

486,807. Electric Hose Signaling Apparatus; W. Fowler, Colorado Springs, Colo. Application filed Feb. 8, 1892. In a hose signaling apparatus the combination of a source of electricity, a circuit composed of three wires attached to the hose, a bell or other signaling device located at each extremity of the line of hose and within the circuit, a third bell or signaling device located and connected by branch wires with the main circuit, and a push-button for each bell or annunciator, the elements of the apparatus being so arranged and connected that by pressing any button all the bells are simultaneously sounded.



No. 486,634.—System of Railway Signaling.

486,818. Electrical Metal-Working Apparatus; Geo. D. Burton, Boston, Mass. Application filed Oct 26, 1891. The combination of an electric converter provided with two exterior rings of opposite polarity, conductive arms attached to the rings, electrodes mounted on the arms and provided with contact rolls, a freed reel disposed adjacent to one of the electrodes, a pair of forging hammers disposed adjacent to the other electrode, and means for actuating the hammers.

486,820. Electrical Annunciator; Franklin S. Carter, Burlington, N. J., and E. Ward Wilkins, Philadelphia, Pa. Application filed June 14, 1892. In an annunciator, the combination of a bar or plate carrying pins or projections which are in the path of the pointers, and an electromagnet to actuate the bar to move the pins collectively out of the path of the pointers.

486,838. Electric Clock; Martin V. B. Ethridge, Everett, Mass. Application filed Jan. 18, 1892. As an improvement in electrical clocks a lever adapted to be oscillated and provided with a guide and with two electrodes, one fixed and the other movable relatively to the lever, and a loose weight adapted to be moved independently in the guide by gravitation, the arrangement being such that movements of the weight alternately separate and connect the electrodes.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.